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JUN 77 J V LINK, H W UNDERWOOD

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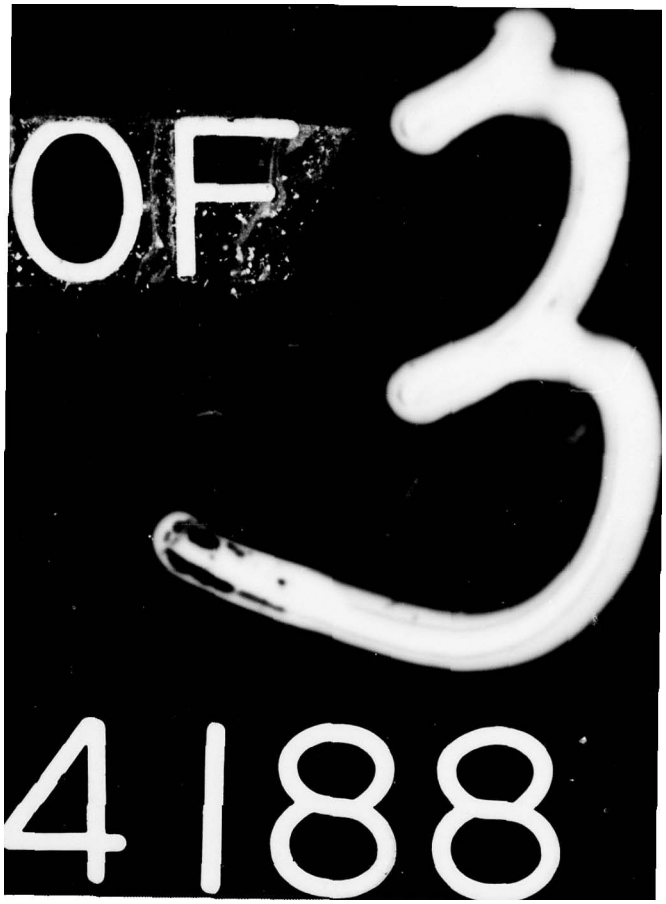
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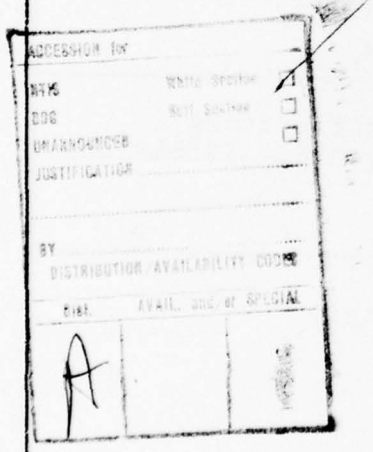
By February 1978, the Air Force will have access to a comprehensive set of guide specifications for the maintenance, repair, and alteration of real property facilities. The specification file is being developed at the direction of the Office of the Chief of Engineers, U.S. Army. This thesis presents the results of a survey of 87 base design offices in the United States. The survey information includes the frequency of the different methods being used to prepare specifications for maintenance and repair projects, the availability of automatic typing equipment, computer access, and microfilm equipment at the design offices. From the survey information and extensive literature review, an economic analysis is developed to determine the feasibility of developing guidelines for each design office to determine whether it could justify automatic typing equipment. The procedure includes the cost of equipment, the portion of a design engineer's salary which is devoted to reviewing and proofing typed specifications, and the typist's time; all of which are dependent upon the number of pages of specifications produced per year. An appendix provides a procedure to be followed by the requesting unit to determine whether the automated equipment can be justified.



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AUTOMATED SPECIFICATION PREPARATION FOR THE BASE CIVIL ENGINEER

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Facilities Management

By

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This thesis, written by

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has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degree of

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

Statement of Purpose

The underlying theme in statements of the mission of Air Force Civil Engineering activities is to provide maintenance, repair, and alteration of existing real property facilities. The Base Civil Engineering (BCE) organization is structured to provide the required maintenance, repair, and alteration of real property facilities through the use of assigned military and civilian craftsmen and also through construction contracts with civilian construction firms (20:2). In Fiscal Year 1975, over $196 million was expended through BCE organizations throughout the Air Force for construction contracts (18). The purpose of this thesis is to investigate the preparation of technical specifications which are used to contract for facility maintenance, repair, and alteration projects (M & R Projects) and to determine whether any benefits will be derived from adopting the use of automated methods of preparing specifications in conjunction with a new maintenance and repair master guide specification which is being prepared at the direction of the Office of the Chief of Engineers, U.S. Army (OCE).

Existing Situation

In order to obtain contractural construction services, each Air Force base has an Engineering Design Section incorporated within the framework of the BCE organization. The professional engineers and technicians employed within the design section are responsible for identifying facility maintenance, repair, and alteration requirements and for preparing the engineering plans and specifications necessary to contract for the work so identified and programmed (20:2). Preparing technical specifications for construction contracts is a time consuming and tedious task. However, the necessity for clear, concise, definitive specifications is one of the most fundamental criteria for any procurement (3:70).

Many civilian architectural and engineering offices have discovered that they are able to prepare project specifications very efficiently while providing consistency and high quality in the final product by adopting the use of master specifications (6:151). Within the federal government, both the military and civilian sectors have developed master or guide specifications for new construction projects. The only known published guidance for maintenance and repair specifications in the federal government is Air Force Manual 91-23, Operations and Maintenance Guide Specifications. This manual provides general guide specifications for 14 M & R topic areas primarily of the service

contract type, but does not require that the guide specifications contained therein be used in the preparation of project specifications (19:i). Air Force Regulation 89-1, Facility Design and Construction--Design and Construction Management, directs the design engineers to use U.S. Army Corps of Engineers Construction Guide Specifications and U.S. Naval Facilities Engineering Command Construction Guide Specifications for the preparation of M & R project specifications. However, since the Army and Navy guide specifications are for the design of new construction projects, AFR 89-1 recommends that they be modified as necessary to fit the requirements of M & R projects (17:2-3, 4).

OCE recognized the lack of guidance in the M & R areas and in January 1975, directed that a project be initiated to develop standardized guide specifications for the maintenance, repair, and alteration of real property facilities (1:8). A full scale effort is now underway at the Corps of Engineers' Construction Engineering Research Laboratory (CERL) which will develop a comprehensive set of Real Property Maintenance Activity (RPMA) Guide Specifications. Of the 65 maintenance activity topic areas identified by the project team to receive guide specifications, 42 are currently under design and are scheduled for completion in February 1978 (8). These master guide

specifications will be a government resource, and as such they will be available for use by all branches of the military.

Final project specifications can be prepared for publication by several methods depending upon the type of original which is available. If the original has been written longhand from "scratch" or if it is a composition of words, sentences, and paragraphs which have been cut from previous project specifications and pasted together to form the new specifications, the final can only be typed manually. However, if the original happens to be a master specification which must only be edited or only slightly altered to fit the existing situation, then the final project specification can be handled quite effectively using an automated method of preparation (7:30). Two automated methods available are automatic typing from a magnetic medium such as tape or cards and computer based text editing programs accessible via computer time sharing.

Statement of the Problem

Currently, there is at best minimal guidance for preparing contractural specifications for the maintenance, repair, and alteration of real property facilities. In order to provide adequate guidance in the M & R area, the Army's Construction Engineering Research Laboratory is preparing a comprehensive set of RPMA Guide Specifications.

On-going reviews of completed specifications by the appropriate agencies in the Departments of the Army, Navy, and Air Force indicate that the RPMA guide specifications will in fact provide usable guidance for preparing M & R project specifications (8). As such, HQ USAF/PRE has indicated that the RPMA Guide Specifications will be adopted for use by the Air Force design offices (12).

The RPMA Guide Specifications fall into the category of master specifications, and as such, they lend themselves to processing via automated methods. If these master specifications are to be used most effectively by the Air Force design offices, the decision to use automated methods of preparation must also be made and appropriate guidance concerning the use of automated equipment must be issued simultaneously with the direction to use the RPMA Guide Specifications. There is no one automated method of preparing specifications which is appropriate to all situations. Intuitively, the degree of automation can range from no automated equipment at all to computer based text editing programs, depending on the size of the office and the workload normally encountered by that office. The problem facing the organization which would issue such guidance is to determine the appropriate degree of automation for the design office involved.

Justification

Regardless of size, all architectural or engineering offices face the same problem when it comes to processing specifications--finding the most efficient means of converting the specification writer's "rough draft into a form which can be reproduced in quantity [7:30]." Basically, this task can be performed manually or mechanically. If the first draft of a specification is a marked up copy of an earlier project, an assembly of manufacturer's data, or a draft written from scratch, the only way it can be prepared in final form is to type it manually. On the other hand, if the first draft happens to be a master or guide specification which must be edited, it can be processed mechanically. The use of master specifications forces a degree of standardization upon the firm, and when used in conjunction with an automated processing system, it offers higher productivity, reduced number of errors, and allows faster incorporation of new data (7:30). A recent textbook written about construction specifications states that when a master specification is used with automatic typing equipment, many problems, even those of retyping and reproofing are almost totally eliminated. Such equipment should be considered to be an integral part of any package whenever a master is considered for use (6:145). When about one half or less of the material is unique on a given project, typing is usually the most expensive approach to producing the

specification. At the other end of the spectrum, computer aided specification programs can result in substantial cost savings and reduction in errors. These systems usually provide the fastest means of producing a final set of specifications. Automatic typewriter or word processing equipment is slower than the computerized system, but it also has its place in the processing field (5:80). Each of the methods available for the mechanization of specification processing has many variations. The exact method used depends on the volume of work generated in the office and the cost of the process. The smaller office may not be in a position to use any of these systems economically, whereas a large office may use all or any combination of methods. Mechanization should allow an office to cut down on the expense of specification preparation and provide more complete and uniform services; both results are desirable in any size operation (6:123).

In his report, "Specification Preparation Methods--State of the Art," E. S. Neely, Jr. reported a summary of the comments made by respondents to his questionnaire when addressing their perceived changes brought about by adopting a computer aided master specification system within their organizations.

1. Consolidation of a firm's specification reference files into a "Master Specification" and standardization of text within that master specification has reduced the possibility of errors during preparation,

as well as the amount of writing required by project personnel.

2. Proofreading and typing requirements are reduced and in several instances eliminated, making errors and omissions less probable.

3. Both the number of personnel required to prepare project specifications and the time required to complete the specifications are reduced, which in turn releases resources that were previously unavailable. Respondents report that these resources have been removed or reassigned to research and development of new master specifications or updating of existing ones.

4. The quality of the master specifications has improved because of these more frequent reviews and updates.

The respondents were pleased with the quality of the specifications produced by their computer systems [10:12].

The greatest cost of implementing a mechanized specification processing system occurs in the preparation of a master specification. Firms who have gone to the trouble and expense of preparing a master specification find that its existence and use saves as much as or more than the adoption of some computer system to edit and reproduce the specification. These savings could also result with the proper use of the master in combination with some of the more modern word processing machines (5:80).

In this instance, the Air Force finds itself in a very fortunate situation. The Army has developed the master guide specifications and will maintain and update them, while making their use available to the Air Force. Therefore, the only costs associated with modernizing the

current methods of preparing specifications at Air Force installations should be those associated with equipment purchase or lease, connection of this equipment, and associated operator personnel training costs.

BACKGROUND

Prior to the establishment of the U.S. Air Force as a separate branch of Armed Forces in 1947, air power was an extension of the U.S. Army. The National Security Act of 1947 transferred the personnel and facilities of the Army Air Forces to the U.S. Air Force (2:379). However, the Air Force has been dependent on the Army Corps of Engineers and the Naval Facilities Engineering Command for support in connection with the design and construction of new Air Force facilities (13:17).

> Unless otherwise designated by the Office of the Secretary of Defense, the Army Corps of Engineers or the Naval Facilities Engineering Command is the normal design and construction agent for the Air Force [17:4-1].

In order to carry out their military construction mission, both the Army and the Navy have developed and maintained construction guide specifications for construction of new facilities. The use of these guide specifications is required for the design of new Air Force facilities (17:2-8). Since the same specifications have been used as a basis for the construction of real property facilities on both Army and Air Force installations, it is logical to conclude that

except for minor deviations, Army and Air Force facilities are comparable. It is further logical to conclude that the Army Facility Engineer design staffs and the BCE design staffs face essentially the same maintenance and repair problems on a day to day basis, and could use the same guide specifications in preparing contract specifications to correct these problems.

Using FY 1975 as a typical year, approximately 7800 separate construction contracts totalling more than $196 million were prepared by Air Force base level units with each contract requiring the preparation of a technical specification (18). There are two primary Air Force sources of guidance for preparation of project specifications, AFR 89-1, Facility Design and Construction--Design and Construction Management, and AFM 91-23, Operations and Maintenance Guide Specifications. (Supplemental guidance to these publications is provided by each major command as necessary.) AFR 89-1 directs the use of Corps of Engineers and Navy new construction guide specifications for maintenance, repair, and alteration projects, indicating that "these specifications must be modified as necessary [17:2-4]." Modification is necessary in virtually all cases since these guide specifications pertain only to new construction while the Air Force base level design sections are primarily concerned with the maintenance, repair, and alteration of existing facilities. Recognizing that

modifying new construction specifications is a problem, AFR 89-1 also authorizes the development of a local guide specification when necessary (17:2-4).

The other Air Force source is AFM 91-23, Operations and Maintenance Guide Specifications, which provides general guidance on specification preparation for 14 topic areas.

> These specifications are not intended to be used as published herein. Normally they will require adaptation to local conditions and modifications to fit existing circumstances. Some contracts may cover more than one area or subject and consolidation of general and technical provisions will be required [19:i].

It should be noted, however, that the " . . . use of Operation and Maintenance Guide Specifications is not mandatory, and they are not intended to replace adequate existing specifications [19:i]." Consequently, some bases have developed their own local or "master" guide specifications for the more common project types such as those listed in AFM 91-23. These local guide specifications are usually developed by combining various sections of previously prepared successful specifications from similar type work into one general specification for a particular type of work, or just using an old project specification as a guide and modifying it as necessary. Although many good specifications are developed in this manner there is a significant possibility of perpetuating mistakes and using out of date material (6:143-5).

Strong justification is provided for the proper preparation of contractural specifications in a text entitled Government Contract Law. This text is used for instructing both Procurement Officers and Civil Engineering Officers in contracting methods at the Air Force Institute of Technology, School of Systems and Logistics.

> The work statement, specifications, drawings, and item description formulate the very heart of any procurement. Whether or not a contract will be successfully performed is quite often determined, not at the time the contract is negotiated or award made, but rather at the time the purchase or performance description is written. The need for clarity and preciseness of expression is perhaps greater in contracts than in any other form of communication. The extent to which this is or is not accomplished will have a direct bearing on the ultimate outcome of a contract. The greatest care, therefore, is required in formulating descriptions of desired products or services. A good job well done, results in savings in time, money, effort and administrative headaches [3:68].

Since construction contracts are procured through formal advertising procedures,

> The necessity for definitive specifications is clearly one of the most fundamental criteria for formal advertising. A sufficiently detailed and complete description of what the Government intends to buy is essential.
>
> All bidders must understand what is being bought, without need for further clarification, in order that the product offered will comply with the specifications and will fulfill the Government's need.
>
> The real problem in writing specifications for technical items, and to a lesser extent for standard items, which are suitable and adequate for use in formal advertising, is to convey a complete and accurate understanding of what is required. The same word or expression is subject to varying interpretations by different people. The prospective bidder in formal

advertising will invariably interpret the specification requirement to his own advantage. It is essential that he do this, otherwise, he will lose out in the fierce price competition. A specification is essentially the transfer of knowledge between minds. Each mind will test the words of a specification against his own experience. In formal advertising, the prospective bidder must make his own interpretations in advance with no assistance from the Government.

Specifications for use in formal advertising must be much more precise than in the case of negotiation. This is so in that in advertised procurement there can be no opportunity, after the opening of bids, to discuss various possible interpretations to be sure of mutual agreement, as there is in negotiated procurements. Also, because competition in formal advertising is limited to price alone, bidders are likely to offer the minimum quality item which will be responsive. This means that the specifications must be immune to degradation by bidders which might result in the Government's getting an inferior product [3:70].

The following are general rules applied to questions involving performance and specifications. It should be noted that individual circumstances can alter their application:

(1) When the Government provides complete design information there is an implied warranty that an acceptable product will result if specifications are met.

(2) If frustration is encountered in determining the meaning of conflicting or ambiguous specifications, interpretation will be in favor of the contractor if the language was written by the Government.

(3) The Government is entitled to strict compliance with quantitative specifications although substantial compliance may be held to be sufficient.

(4) Qualitative specifications are interpreted in the light of custom and usage in the particular trade or profession (watertight) [3:72].

Engineers in all three services have recognized the need for standardized construction guide specifications for

real property maintenance, repair, and minor construction projects that meet the requirements discussed above. As mentioned earlier, the Air Force has published AFM 91-23, and in 1975, the Department of the Navy made a small effort toward preparing maintenance and repair guide specifications for 12 topic areas (1:7). By far the most significant development in this area is the work currently being performed by the Army. Their recognition is clearly stated in the following:

> The Facility Engineer is faced with preparing a wide range of specifications covering architecture and all engineering disciplines for the full scope of RPMA activities. Military Construction Guide Specifications (MCGS) or Federal Construction Guide Specifications (FCGS) are available and suitable for minor construction projects but no guide specifications exist for the remaining RPMA activities. Specifications and contracting methods have been developed over the years to handle these other activities with several inherent deficiencies. The system is not tied to a set of guide specifications which ensure up to date and complete coverage of a subject. Since each organization publishes their specifications there is little uniformity between organizations which could create problems for contractors. Specification writing is a technical skill area in which individuals must be deeply involved to keep current on development and maintain an understanding of the requirements. Many Facility Engineers do not use professional specification writers and must depend on engineers trained in other specialties. Guide specifications will provide the means of standardizing specification requirements, introduce a level of consistency into the overall program, and greatly assist the engineer in preparing job specifications [1:1,2].

As a result, in January 1975, the Office of the Chief of Engineers, U.S. Army, requested CERL to prepare a plan for the development of standardized maintenance and repair guide specifications (1:8). The instruction transmitted to CERL

signaled the start of the largest single undertaking by any service to prepare standardized maintenance and repair guide specifications.

RPMA Guide Specifications

Real Property Maintenance Activity (RPMA) guide specifications are standardized specifications developed specifically for maintenance, repair, and alteration of real property facilities as well as services performed in connection with the upkeep of real property facilities (1:1). To date nearly $1.5 million has been funded for the development of 49 of the 65 topic areas identified (See Appendix B for a complete list of topic areas). It is expected that guide specifications for 42 topic areas will be completed by February 1978. Development of the remaining 23 topic areas will be scheduled sometime this year (8).

The RPMA specifications are being developed using the Construction Specification Institute (CSI) format of 16 major topic divisions with an additional 6 divisions added to include topic areas peculiar to RPMA requirements. Each specification is organized into a four-part handbook which

> . . . is designed to assist the . . . [designer] in determining the condition of facility components, assist the cost estimator in developing the government estimate for the proposed project, the specification writer in developing and producing adequate specifications, and the procurement specialist in preparing and managing contract documents [24:i].

Part I is a deficiency checklist for the [designer's] use in identifying facility requirements. This checklist is then used as a guide for estimating the cost to correct these deficiencies (24:i).

"Part II discusses contracting methods and recommends appropriate unit price schedule items [24:i]." This information can be used as a guide during project procurement.

Part III contains the guide specification, with the first section being the general specification for that topic area. This general specification should be used in all specifications concerning that topic. "Subsequent sections are written around very narrow scoped topics and are intended to be used in conjunction with the general specification section [24:i]." All sections of the specification are prepared in a three-column format. The first column contains notes to the specification writer regarding recent changes to the specification, specific instructions regarding that particular section, or other options. The second column contains the specification itself, and the third column is to be used by the specification writer to make notes or instructions to the typist regarding necessary changes to the specification.

Part IV is prepared in a two-column format. The first column lists the specification itself, and the second column is used to list the notes the specification writer

had indicated in column three of Part III. These notes will indicate the changes the specification writer has made to the standard guide specification in adapting it to his particular project (See Appendix C for a sample RPMA Guide Specification).

The aforementioned procedure and format for preparing the specifications is intended to be used when the final specification is prepared manually. The two-column format will eliminate virtually all of the repetitive typing, leaving only notes and special paragraphs to be typed in the specification.

The EDITSPEC System

The U.S. Army currently plans to maintain the master of the RPMA guide specifications on a computer master file, in order to facilitate necessary changes to keep the specifications current. A computer based text editing specification system called EDITSPEC has been designed to meet the specific needs of the Corps of Engineer designers in preparing construction specifications. This same system will also accomodate the RPMA specifications, although the final decision to put the RPMA specifications on the EDITSPEC program has not been made to date. The EDITSPEC system provides for direct user access to the specification master file by remote terminal/printer with the capability for detailed editing of the specification to fit user needs.

Once the specification has been edited to user satisfaction it can then be rapidly printed at the remote terminal in final form ready for reproduction and further processing (9).

The advantages of this type of system include: faster production of project specifications; reduction in specification errors; reduction in the number and cost of change orders required because of inaccurate or incomplete specifications; an increase in productive time of design engineers by relieving them of the tedious and mundane tasks such as proofreading or the development of a complete new specification; and an overall reduction in clerical personnel necessary for typing specifications (10:12). Additionally, the RPMA specifications will be continuously updated by central site personnel thus providing a current specification to the using field units at all times.

Some obvious disadvantages are the high equipment and connection costs for remote terminals/printers at each using location, the cost of maintaining the specifications on a central computer, and the training of base personnel to operate the EDITSPEC program. The feasibility of putting remote terminals at each Army Facility Engineer location is currently under study by CERL. This study is oriented toward determining the workload volume of an engineering design section that will economically justify the installation of a remote terminal/printer (8).

OBJECTIVE

The objective of the proposed research is to formulate a procedure which each design office can follow to determine if it can economically justify the acquisition of automated specification production equipment.

RESEARCH QUESTIONS

1. What is the manpower posture of the design sections at Air Force bases in the continental United States?

2. What is the expected workload of the various design sections?

3. What methods of preparing specifications are currently being used by the various design sections?

4. What equipment is presently available at the installation to assist the project engineers in preparing contract specifications?

5. What additional design guidance have each of the major commands issued to the design sections at bases under their jurisdiction?

6. Can a procedure be developed using the parameters of an Air Force design section which would assist those personnel in determining if automated methods of preparing specifications can be economically justified for their particular situation?

CHAPTER II

METHODOLOGY

Description of the Population

As established earlier, Air Force bases were designed, built, and upgraded by the U.S. Army Corps of Engineers and the Naval Facilities Engineering Command using their construction guide specifications as the basis for all design. Although these bases are located in virtually every part of the United States, and the age and use of the facilities vary from base to base, it is logical to conclude that overall, the facilities throughout the Air Force are comparible. The maintenance, repair, and alteration of these facilities is the responsibility of the design engineers assigned to the BCE organization at each base. Because of the similarity of facilities, it is conceivable that engineers on the staff of any BCE design section could face similar types of maintenance, repair, and alteration problems on any given day. Therefore, the population of interest in this study will be the engineering and design staffs assigned to Air Force BCE organizations within the continental United States.

Specifically excluded from the survey will be the design staffs of all overseas bases. The engineers employed

at these locations are primarily natives of the host country who have been educated and trained in the construction practices and customs of their own country. It would not be appropriate to direct them to use guide specifications which have been prepared in accordance with the practices and customs of the United States construction industry.

Sampling Plan

Since there are less than 100 Air Force bases which have design staffs assigned to the Base Civil Engineering organization, a census of all of the bases will be made. Since the survey will bear a Reports Control Symbol, a return rate of 80% to 95% is expected. This high rate of return will provide sufficient data to allow generalization to the entire population. In addition to the survey of the base level design sections, a second survey will be made of each major command Engineering and Construction Management Division in the continental United States.

Period of Survey

Fiscal Year 1975 was selected as a recent year representative of the funding levels to be expected in the operation and maintenance of Air Force real property facilities. By FY 1975, the major effort in Southeast Asia had subsided and the funding programs which had supported that effort had been closed. A larger proportion of the funds allocated to the Air Force was being directed for use on

facilities in the United States than during the Vietnam war. FY 76 could not be chosen as the representative year because of the additional transition quarter added to that fiscal period. Although special funds were allocated for the transition quarter, in many instances, confusion could result in categorizing projects designed and procured in FY 76 as opposed to those procured in the transitional quarter.

Data Collection Plan

A survey will be made of the base level engineering design sections to elicit information about the physical aspects of each organization and the design practices employed in the different organizations. Questions dealing with the numbers of construction projects and their dollar amounts will be asked in order to determine the workload in the section. Information about the number of engineers and technicians who are responsible for designing construction projects, equipment available for assistance in the design process, and project preparation methods will be collected to assess the present capabilities of the design staffs.

A second survey will be made of the major commands within the population of interest to elicit information about command policies regarding technical review of projects, command issued design guidance, and project funding. The information gained from this source will be used to help

explain any trends or patterns which may become evident when the data obtained from the base level design sections is analyzed.

Validation of Survey Questionnaire

In order to assess the validity of the questionnaires, copies were given to several instructors in the AFIT Civil Engineering School and to several Civil Engineering Officers who are students in the AFIT School of Systems and Logistics. Critiques received from the pretest have been used to change or adjust several items on the questionnaires.

DEFINITIONS

Identification of Terms

Major Command--One of ten listed commanding headquarters which has fiscal or technical control over one or more Air Force bases.

Design Section--A technically oriented working group within the Base Civil Engineering organization which is responsible for the engineering management and the preparation of plans and specifications for construction projects for all real property facilities under the control of a particular Air Force base.

Construction Projects Designed--All maintenance, repair, minor construction, Non-Appropriated Fund

construction, and family housing construction for which contract plans and specifications were prepared.

Service Contract--Any project specification which is written for services to be procured in connection with the maintenance and upkeep of real property facilities, such as custodial services, trash collection, or maintenance of fire or security alarm systems.

Projects Procured--All above listed projects which were subsequently funded and placed under contract.

Funded Amount--The total dollar amount initially funded for all projects procured--not to include subsequent costs for modifications or change orders.

Change Orders--Any written modification to a contract after its award. This will include all increased-cost, decreased-cost, and no-cost changes whether they were the result of design deficiencies, increases or decreases in scope, or changed conditions.

Amount of Change Orders--The difference between the initial contract amount and the final contract amount.

Design Engineers--All personnel employed in positions which are designated Engineer or Engineering Technician whose main duties and responsibilities include the development of plans and specifications for construction projects.

Methods of Specification Preparation

A. Individually write each entire specification--This refers to the process of a design engineer writing in long hand at least 75% of a complete specification and forwarding the draft to an administrative clerk for typing.

B. Cut, paste, and edit old specifications--The process of reusing previously written specifications by cutting appropriate portions from them and pasting those portions together to form a new specification. This includes rewriting or editing portions of that specification to fit the situation of concern. The final "pasted copy" is retyped in final form.

C. Assemble Corps of Engineers Guide Specifications to fit a project--The process of producing copies of Corps of Engineers Guide Specifications and assembling them in a logical order to form the appropriate portions of a project specification. Copies are often made from commercial microfilm systems such as Showcase or VSMF.

D. Use local master specifications or guide specifications--The process of using appropriate portions of locally produced standard specifications for certain projects. These specifications are usually produced and used command wide.

E. Use automatic typing equipment to reproduce standard specifications--The use of automated typewriters

such as IBM Selectric-MagCard II Systems. The specification is typed on magnetic tape or cards, indexed, and stored for future use. When a similar project must be prepared, the magnetic tape or cards are retrieved to reproduce the specification automatically. The engineer then edits the specification to fit the project and returns it for final reproduction.

F. Use computer based standard specifications--The use of any commercially available computer-based specification preparation system. The data base may be stored in computers used on the base, at the major command or privately (or commercially) owned which are accessed via time sharing methods.

Tabulation of Survey Data

The data gathered from the base level survey response will be used to establish a basis for recommendations which will be made in relation to the use of automated equipment for the preparation of project specifications. A table will be constructed to indicate each base which responds, its parent major command, the number of design engineers assigned, the number of projects which were designed in FY 1975, and whether it has automated specification preparation equipment. Additional tables will be developed to display information which is grouped according to the major command. These tables will indicate

funding, manning, equipment possession, and method of preparing specifications currently being used. This information will be consolidated by major command in order to be able to relate any trends, relationships, or patterns which may develop to guidance or procedures required by the parent major command.

The information received from the major command survey will also be tabulated so that the various procedures and supplemental command guidance to the base design offices can be easily reviewed. Any conclusions drawn from comparisons of the different command policies or procedures as they relate to their bases or as they differ among the commands will be purely subjective.

Decision Criteria

The determination of which method or combination of manual and automated methods of using the RPMA Guide Specifications in base level Air Force design offices will depend on a number of factors. The most important of these factors are: 1.) the method which the Army ultimately adopts to maintain and store the master RPMA Guide Specifications; 2.) the manner in which the Army adopts to distribute and update the basic specification once it has been issued to the using design offices; 3.) whether commercial microfilm/microfisch information handling and distributing firms such as Information Handling Systems (VSMF) and Showcase will

market the RPMA Guide Specification as part of their existing governmental/military libraries; 4.) the amount and type of automatic information handling and processing equipment which is presently available at the various Air Force design offices; and 5.) the annual specification workload at each design office. Each of these factors will have some impact on the available options and may limit the choice of methods available for handling and processing the guide specifications.

Three methods of handling and processing the RPMA Guide Specifications will be considered and discussed herein: 1.) editing and manually retyping from paper copy while retaining a reference copy on microfilm; 2.) committing the basic guide specification to magnetic cards or tape for use with automatic typing equipment while retaining a permanent microfilm copy for reference; and, 3.) automatic typing and editing from a computer data-base text editing program while retaining a permanent microfilm copy for reference. A procedure will be developed to assist in determining which method should be recommended for use at a particular design office. However, prior to developing this procedure, a discussion of the limiting factors enumerated above along with their perceived impact on each of the methods of handling and processing the guide specifications will be presented.

Method 1, manually typing from a microfilm file base, is only applicable if commercial information handling firms such as VSMF and Showcase arrange to commit the RPMA Guide Specifications to a microfilm medium and distribute it as part of their existing governmental/military libraries. An unofficial interview with representatives of VSMF indicated that the firm is interested in providing the new specification as part of its service. If the specification is made available commercially via microfilm, the problem of distributing revisions will have been solved for those offices which have the microfilm handling equipment and appropriate libraries. If this method of maintaining a data base is chosen, a commitment must be made to insure that each design office has the proper reading equipment and microfilm libraries.

Method 2, committing the specification to magnetic cards or tape while maintaining a microfilm file copy, is applicable only if there is sufficient workload to justify the automatic typing equipment. The same stipulation that was made for Method 1 regarding the availability of microfilm equipment and libraries also applies to this method. If the survey indicates that most design offices already have automatic typing equipment, the recommendation to commit the RPMA Guide Specifications to magnetic medium will be made immediately. A procedure which will provide guidance on how to determine whether it is economically feasible

to invest in automatic typing equipment will be developed later in this chapter. If the procedure indicates that certain combinations of manning and workload volumes would provide justification for investment in automatic typing equipment, that recommendation will then be made along with the proper guidelines for justification.

Method 3, automatic editing and typing from a computer data-base text editing program with a microfilm file copy, is entirely dependent on OCE making the final decision to maintain the specification package on the EDITSPEC program. Air Force access to the computer data-base will also be necessary in order to interact with the specification. The final decision to maintain the master specification on the EDITSPEC program has not yet been made, therefore the assumption will be made that OCE will in fact decide on that course of action and that the Air Force will be allowed to have access to the program on a user basis. User basis means that the person using the program may interact with and manipulate the text, but not change the basic program. A similar economic feasibility procedure to the one described under Method 2 will be prepared for the computer method. The decision as to whether to recommend this method will be based on the economic feasibility of the system.

Economic Analysis Procedure

A basic economic analysis will be developed to determine if there is a workload level at which it is economically feasible to adopt automated methods of preparing specifications. Once that has been established the analysis will be used to determine which degree of automation is applicable for a particular design office. The analysis will provide a procedure which will be based on the salary of design engineers which are authorized in the design section, (Functional Code 4421), the salary of typists devoted to typing specifications, the number of project specification pages produced per year, and the cost of equipment used to produce the specifications.

The basis of comparison will be manual typing of the project specification from the design engineer's edited copy of the RPMA Guide Specifications. The procedure will be based on the following assumptions:

1) All equipment will be leased with the exception of the manual typewriter. The purchase price will be spread over the unit's 5 year normal life at an interest rate of 10% to determine annual cost.
2) Costs will be compared on an annual basis.
3) Cost of ribbons, paper, and supplies will be approximately the same regardless of method and will be ignored in the analysis.

4) The benefits derived from utilizing a master specification will be the same regardless of method utilized; therefore, these benefits will not be considered in the analysis.

5) Typists considered in this analysis are devoted full time to typing specifications.

6) Design engineers and typists will be paid at a median rate of GS-11, step 4 and GS-4, step 4, respectively.

7) Specifications typed by the manual method will have to be retyped at least once, therefore a factor of 2 will be used in determining the number of typists required for the manual method (4:34).

8) The computer/printer will be used only for producing specifications.

As an initial base line for comparison, the cost per page of specifications produced using the current method will first be determined. The following relationship will be used whether comparing automatic typing to manual typing, computer production to manual typing, or computer production to automatic typing.

$$CPP = \frac{(E \times SE) + (R \times T \times ST) + EC}{P} \qquad (2.1)$$

where

CPP = cost per page of specification produced

E = number of design engineers assigned (yearly average)

SE = portion of engineer's annual salary in dollars spent reviewing and proofreading specifications after they have been typed

T = number of typists devoted to specifications

ST = typist's annual salary in dollars

EC = annual equipment costs. Yearly rental costs for rental equipment. Yearly costs for purchased equipment amortized over 5 years at 10% discount factor.

P = number of pages of specifications produced per year.

R = retyping factor. R = 2 if comparing manual typing to any other method, 1 otherwise. This accounts for having to retype everything at least once when using the manual typing method. In the Industrial Engineering study cited, a factor of 3 is recommended, however, a factor of 2 was chosen for preparing specifications because about 85% of the time the initial typing begins from a "cut and pasted" specification or from a previously developed master file (4:34).

For the purpose of this paper the number of design engineers will be determined from the survey results and verified by Unit Detail Listings (manning authorization documents) of each design unit. The number of typists devoted to specifications will also be determined from the Unit Detail Listings. Since the actual number of typists devoted to typing specifications only will be unknown, the

following criteria will be used:

Table 2.1

NUMBER OF TYPISTS DEVOTED TO SPECIFICATIONS

# Typists Authorized FC 4420 & 4421	# Typists Devoted to Specifications
1	.5
2	1
3	1.5
4	2.5
5	3

In the actual situation, the Chief of the Design Section will know exactly how much of the typists' time is spent preparing specifications. The rationale used in Table 2.1 is as follows:

If one typist is authorized in the Engineering and Construction Management Branch, it will be assumed that the typist will spend one-half of the time performing secretarial or clerical duties such as answering the telephone, filing, typing correspondence, taking messages, and so forth. The remaining one-half of the time will be spent typing specifications.

If there are two typist positions authorized, one will be devoted to typing specifications and the other to performing clerical and secretarial duties.

If there are three typist positions authorized, one will be devoted to typing specifications, one to performing clerical and secretarial duties, and the third will be split between the two--helping wherever assistance is required.

If four typist positions are authorized, 2.5 will be devoted to typing specifications and 1.5 will be devoted to clerical and secretarial duties.

If five typist positions are authorized, two will be assumed devoted to clerical and secretarial duties while the remaining three are devoted to typing specifications.

The portion of an engineer's salary spent reviewing and proofreading specifications after they have been typed will be determined from a CERL research study performed on specifications (11:12). This figure will be computed as a percent of base salary, obtained from current wage schedules, and will include retirement and other benefits. The typist's salary will also be determined from current wage schedules and will also include retirement and other benefits. Equipment costs will be computed from existing GSA contracts. Although the manual electric typewriter is normally purchased, a yearly cost will be computed assuming a five year life with a discount rate of 10 percent. The number of pages of specifications produced will be determined from the

survey results using the number of projects designed and the average number of pages per project.

Once the basic cost per page of specifications using the current method has been determined, the same relationships in Eq (2.1) can be used to determine the number of pages necessary to be produced by automated methods (automatic typing equipment or computer remote) in order to break even costwise with the current method. The following relationship will be used:

$$RNP = \frac{(E \times SE \times RFE) + (R \times T \times ST \times RFT) + EC}{CPP} \qquad (2.2)$$

where

RNP = the required number of pages which must be produced in order to break even with the cost of specifications prepared by the current method.

RFE = 0.22. The reduction factor which represents the time required by the design engineer to perform the reviewing and proofreading of the specifications after they have been typed manually and are now being typed with automatic typing equipment.

0.09. The reduction factor when comparing computer preparation to manual.

0.41. The reduction factor when comparing computer preparation to automatic typing (11:12).

RFT = 0.61. The reduction factor which represents the time required by the typist to prepare project specifications with an automatic typewriter as compared to preparing them manually.

0.28. The reduction factor when comparing computer preparation to manual.

0.54. The reduction factor when comparing computer preparation to automatic typing (11:12).

EC = annual cost of automated equipment.

The remaining factors are as defined in Eq (2.1).

Note that the cost of equipment is fully absorbed in preparing specifications only. This will yield a conservative value for RNP in Eq (2.2).

The results of Eq (2.2) will yield a breakeven point for any base design unit, and will represent the minimum number of pages of specifications the unit must produce per year in order to economically justify switching from their current typing method to automatic typing equipment or to a computer-based text editing program with a time sharing system. Although the savings in engineer's salary does not represent a recoverable capital savings (i.e., it will not eliminate engineer positions) it does contribute to the true cost of producing specifications and as such will be included in the computations in Eqs (2.1) and (2.2).

Once the computation procedure of Eqs (2.1) and (2.2) has been accomplished, and it has been determined that the unit can economically justify an automated system, the

requirements of existing regulations and manuals must be satisfied. For automatic typing equipment these regulations are: Air Force Regulation (AFR) 4-2, Administrative Systems Program Management; and, Air Force Manual (AFM) 67-1, Supply Manual, Volume II, Chapter 15, Part II, and Volume IV, Part I. For computer access equipment, these regulations are AFM 300-6, Automatic Data Processing (ADP) Resource Management and AFM 300-12, Procedures for Managing Automatic Data Processing Systems. A justification procedure will be developed to aid the base level units in acquiring automated equipment. This procedure will be included as Appendix E (14, 15, 16, 21, 22, 23).

CHAPTER III

SURVEY RESULTS

Base Level Design Section Response

The questionnaire which was sent to the BCE Design Sections was designed to gather information pertinent to answering the research questions posed in Chapter I. The survey results will be presented as they relate to the research questions. Seventy-one of the 87 bases queried returned the completed questionnaires, producing an 81.6% response rate.

Manpower Posture

In response to Question #1, which asked for the total authorized and assigned manning in the design section (Functional Account Code 4421), the consolidated reply totaled 1,411 positions authorized and 1,280 positions assigned. Question #2 asked how many of those positions reported in response to Question #1 were engineers or engineering technicians who are responsible for designing projects. There was apparently some confusion with the wording of the question because in many instances the figures reported were exactly the same as those reported in response to Question #1. The intent of Question #2 was to identify those positions associated with responsibilities of project

design as opposed to those which support project design such as typing, surveying, drafting, and administrative functions. Since the response was mixed for this question, the responses will not be used in the analysis. Table 3.1 indicates those bases which responded to the questionnaire, the number of design engineers authorized, the number of construction projects which were designed in FY 1975, and the number of service contracts designed in FY 1975. In order to rectify the mixed information received in response to Question #2, the number of positions reported by the design section was checked against the number of authorized engineer Air Force Service Code (AFSC) positions on the Unit Detail Listing (UDL). Whenever a response was encountered which included the total number of positions authorized in the design section, the number of engineer AFSC positions authorized as reported on the UDL was used instead. Table 3.1a indicates the manning rate by command.

Expected Workload

As mentioned above, the number of projects designed by each base is listed in Table 3.1. Table 3.2 lists the number of projects designed, the number of those designed that were procured, the number of service contracts procured and the final contract amount. This information is presented with the figures grouped according to major command affiliation. Information about the number and amount of

Table 3.1

ENGINEERS AND PROJECTS BY BASE

	#Design Engrs. Authorized	#Projects Designed	#Service Contracts
Strategic Air Command (SAC)			
Barksdale AFB	10	68	5
Beale AFB	10	65	5
Blytheville AFB	7+	43	4
Carswell AFB**	10+	34	-
Dyess AFB	10+	37	12
F. E. Warren AFB	17+	38	35
Fairchild AFB	13	24	5
Grand Forks AFB	9	-	-
Griffiss AFB**	16	108	121
K. I. Sawyer AFB	10+	54	9
Kinchloe AFB	7+	37	25
Loring AFB	12	50	27
Malmstrom AFB	10	55	17
March AFB	10+	54	17
McConnell AFB	6	29	7
Minot AFB	11+	102	10
Offut AFB	9	46	-
Pease AFB	9	40	19
Plattsburg AFB	9	45	3

Table 3.1 (continued)

	#Design Engrs. Authorized	#Projects Designed	#Service Contracts
Rickenbacher AFB	8	65	11
Vandenberg AFB*	26	48	40
Whiteman AFB	8	32	3
Wurtsmith AFB*	8+	59	30
Tactical Air Command (TAC)			
Bergstrom AFB	12+	114	15
Davis Monthan AFB	9	61	20
England AFB	7	82	8
George AFB	8	61	9
Holloman AFB*	11+	49	7
Homestead AFB	8	57	22
Langley AFB	12+	239	61
Luke AFB	10+	438	16
Mt. Home AFB	10	77	-
Myrtle Beach AFB	7+	107	15
Nellis AFB	11	83	7
Shaw AFB	9+	51	19
Air Training Command (ATC)			
Chanute AFB*	11+	58	99
Columbus AFB	7+	46	2
Craig AFB	7+	44	57

Table 3.1 (continued)

	#Design Engrs. Authorized	#Projects Designed	#Service Contracts
Lackland AFB	15+	91	8
Laughlin AFB*	8	37	11
Mather AFB	10	39	15
Randolph AFB*	10	33	-
Reese AFB	7+	27	30
Sheppard AFB**	12+	43	-
Webb AFB	7+	20	4
Williams AFB	8+	17	4
Materiel Airlift Command (MAC)			
Altus AFB	9+	95	52
Andrews AFB*	18+	225	40
Charleston AFB*	9+	80	49
Dover AFB*	11	92	60
Little Rock AFB*	11	99	16
McChord AFB†*	11+	236	91
McGuire AFB*	13	65	70
Norton AFB	11+	67	18
Scott AFB*	13+	60	-
Air Force Logistics Command (AFLC)			
Hill AFB	28+	130	77
Kelly AFB**	19+	61	63

Table 3.1 (continued)

	#Design Engrs. Authorized	#Projects Designed	#Service Contracts
McClellan AFB**	22+	-	-
Newark AFS	5+	19	2
Robins AFB**	19+	-	-
Tinker AFB	25+	85	104
Wright-Patterson AFB**	34+	114	70
Air Force Systems Command (AFSC)			
Brooks AFB	6+	70	15
Edwards AFB**	15+	103	23
Kirtland AFB**	20+	78	18
L.G. Hanscom AFB**	10+	65	20
Air Defense Command (ADC)			
Duluth I. A. P.	5+	167	200
Hancock Field†	2+	27	7
Peterson AFB	10+	31	5
Air University			
Maxwell AFB	12+	126	60
U.S.A.F. Security Service			
Goodfellow AFB**	4+	30	-

*Denotes possession of automatic typing equipment.

**Denotes access to computer programs.

†Denotes microfilm information handling equipment not available.

+Denotes authorized positions as shown on UDL.

Table 3.1a

ASSIGNED VERSUS AUTHORIZED
STRENGTH BY MAJOR COMMAND
(FUNCTIONAL CODE 4421)

	Functional Code 4421		
MAJCOM	Assigned	Authorized	%
SAC	419	384	92%
TAC	214	190	89%
ATC	180	167	93%
MAC	205	188	92%
AFLC	245	219	89%
AFSC	97	91	94%
ADC	24	19	79%

Table 3.2

PROJECT DATA BY MAJOR COMMAND

	#Bases		#Constr.Projects		#Amount
MAJCOM	Surveyed	Responding	Designed	Procured	Procured($000)
SAC	25	23	1133	833	41,307
TAC	15	12	1419	1359	52,041
ATC	14	11	473	385	24,795
MAC	11	9	1019	821	26,258
AFLC	7	6	409	327	16,658
AFSC	6	4	316	272	9,530
ADC	4	3	384	334	7,412
AU	1	1	126	115	3,200
USAFSS	1	1	30	22	1,710

Table 3.2 (continued)

	#Bases		ServiceContr.		Total	
MAJCOM	Surveyed	Responding	#Designed	$Amt.($000)	#Projects	$Amt.($000)
SAC	25	23	402	4,338	1,235	45,645
TAC	15	12	199	3,947	1,558	55,988
ATC	14	11	230	4,113	615	28,908
MAC	11	9	411	6,702	1,232	32,960
AFLC	7	6	316	5,526	643	22,184
AFSC	6	4	76	1,808	348	11,338
ADC	4	3	238	928	572	8,340
AU	1	1	60	750	175	3,950
USAFSS	1	1	-	-	22	1,710

change orders was also requested, but 28% of the bases replied that that information was not available. It will not be used in the analysis.

Methods of Preparing Specifications Employed

In order to determine what methods of preparing specifications are being used by the designers at the bases, six of the most common preparation methods were defined on the questionnaire, and the respondents were asked to identify the percentage of the projects designed in their office which were prepared using each of the methods. A seventh category called "other" requested a description of any other method being used which did not fall into one of the six categories. There were only 70 responses to this question because one of the respondents chose to answer with descriptive terms such as "too many" and "not enough." A tabulation of the responses is presented in Table 3.3.

Only two of the bases reported that they use a specification writer to prepare project specifications to some extent. Andrews AFB reported that 75% of its specifications were prepared by a specification writer and McClellen AFB reported 20%. Kirtland AFB reported that they were considering changing to the specification writer approach, and Lackland AFB reported that a specification writer position was authorized, but the position had not

Table 3.3

METHOD OF SPECIFICATION PREPARATION*
% BY METHOD

MAJCOM	#Bases Total	Respon	A Write 75% Longhand	B Cut&Paste Exist.Specs	C Assemble CofE Guide Specs
SAC	25	23	15	41	24
TAC	15	12	12	45	17
ATC	14	11	9	48	36
MAC	11	9	9	29	30
AFLC	7	6	24	31	38
AFSC	6	4	11	43	11
ADC	4	3	36	47	17
AU	1	1	22	75	1
USAFSS	1	1	2	3	60
	**Summary	70	15	40	24

*Expressed as a command average, % of specifications prepared by each method.

**Expressed as a %, based on a weighted average by number of projects designed.

Table 3.3 (continued)

MAJCOM	#Bases Total	#Bases Respon	D Use Local MasterSpecs	E Use Auto TypingEquip	F UseComputer BasedStdSpecs	G Other
SAC	25	23	12	8	0	(Insig)
TAC	15	12	18	8	0	0
ATC	14	11	3	1	0	3
MAC	11	9	7	24	0	1
AFLC	7	6	5	2	0	0
AFSC	6	4	18	17	0	0
ADC	4	3	0	0	0	0
AU	1	1	2	0	0	0
USAFSS	1	1	35	0	0	0
**Summary		70	11	10	0	(Insig)

** Expressed as a %, based on a weighted average by number of projects designed.

been filled. All of the other bases reported that the design engineer prepared his own specifications.

Automated Equipment Available

Eleven bases reported that they had access to computer programs which aided in the solution of engineering problems. The types of programs which are available to these bases are typically quantitatively oriented. Some examples of the programs include those which solve heat-load problems, balance air conditioning loads, electrical distributions, and lighting systems, calculate loads on airfield pavements, and keep track of daily time reporting by project. Two bases reported that they had access to commercial time-sharing systems, but they did not specify which programs were available. The information collected concerning computer access is presented in Table 3.4.

Table 3.4

NUMBER OF BASES PER COMMAND
WHICH HAVE ACCESS TO COMPUTER PROGRAMS

MAJCOM	# Bases	Remarks
AFLC	4	
AFSC	3	1 Leased
SAC	2	
ATC	1	
USAFSS	1	Leased

Nineteen bases reported that they either leased or owned automatic typewriters of either a magnetic tape or magnetic card medium. Thirteen bases reported that they possessed IBM equipment, four have Redactron equipment, one has a Remington Rand, and one has a Savin unit. The information is presented by major command in Table 3.5.

Table 3.5

NUMBER OF BASES PER COMMAND
POSSESSING AUTOMATIC TYPING EQUIPMENT

	Automatic Typewriter			
MAJCOM	IBM	Redactron	Remington	Savin
MAC	6		1	
SAC	2	1		
ATC	2	1		
AFLC	2			1
AFSC		2		
TAC	1			

Sixty-nine of the 71 bases responding reported that they lease microfilm libraries and either lease or own microfilm reader/printer equipment. Table 3.6 depicts the information, showing the number of bases per major command which possess microfilm information handling equipment and whether they rent the Showcase or VSMF libraries. Presently Showcase and VSMF are the only firms reported in the survey which market microfilm libraries containing military and federal standards and specifications along with building product information.

Table 3.6

NUMBER OF BASES PER COMMAND
RENTING MICROFILM LIBRARIES

MAJCOM	# Bases	VSMF	Showcase
SAC	23	17	6
TAC	12	8	4
ATC	11	6	5
MAC*	8	5	1
AFLC	7	7	
AFSC	4	4	
ADCOM	2	2	
AU	1	1	

*2 bases did not specify system

Major Command Survey Results

Ten of the 11 major commands surveyed returned completed questionnaires yielding a 90.9% response rate. Each command replied that there are engineers on their staff whose responsibilities include reviewing projects which are submitted for technical review by the bases within their command. Each major command except two reported that its staff had reviewed projects for technical sufficiency during the survey period. Only AFLC and AFSC replied that they had computer programs available for solving engineering problems and that the programs were available to the design offices within their command. None of the major commands reported that they had directed the use of other than Corps of Engineer Guide Specifications at any of the bases within their command. AFSC did mention that Federal Housing Administration Guide Specifications are required for use within

that command. Seven of the major command's Engineering Divisions had supplemented AFR 89-1 and had passed on other guidance to their bases; however, the supplements and additional guidance issued by the major commands dealt primarily with construction management procedures, progress report submission, and programming information. There was no specific design guidance issued in addition to that already covered in existing Air Force directives. The results of the Major Command Survey are presented in Table 3.7.

Table 3.7

RESULTS OF MAJOR COMMAND SURVEY

MAJCOM	#Review Engrs.	#Projects Reviewed	Computer Programs Available	Additional Command Guidance: Command Guide Specs	Additional Command Guidance: Sup to AFR 89-1	Additional Command Guidance: MAJCOM Regs	Additional Command Guidance: Other
SAC	41	685	No	No	Yes	SAC Reg 89-1	Del. of Fund App. Limits
TAC	9	-	No	No	No	No	"
ATC	9	444	No	No	Yes	Reg 85-7 Reg 88-1	"
MAC	14	-	No	No	Yes	Sup to AFR 86-1	"
AFLC	9	150	Yes	No	Yes	Sup to AFR 86-1	"
AFSC	6*	150	Yes	No	No	No	"
ADCOM	8	160	No	No	Yes	No	"
AFCS	5	25 80 Funct. Suff.	No	No	Yes	No	-
AU	1	10	No	No	Yes	Sup to AFR 86-1	-
USAFSS	-	-	-	-	-	-	-
AFRES	6	40	No	No	No	No	-

*+ 11 reserve officers

CHAPTER IV

ECONOMIC ANALYSIS

Introduction

As mentioned in Chapter II, the decision as to which method of preparing specifications is best for each base is dependent on the availability of the RPMA specifications either through paper copy or microfilm distributors, or through a computer time-sharing system. Whether the computer system or the microfilm storage system will be available is not known at the time of this writing. However, the assumption is made that the RPMA specifications will be available to Air Force bases in one form or another.

The intention of developing the procedure as described by Eqs (2.1) and (2.2) was to be able to determine the specification workload of each design section necessary to justify upgrading from manual to automated methods of preparing specifications. The survey results were to provide sufficient data to make this determination. However, the survey results did not yield all the data necessary to do so. Specifically, Eq (2.1) requires the number of pages of specifications produced (P) to be a known value. The survey results provided only the number of projects produced by each responding base during FY 75 and not the number of

pages. To determine (P) for each base, the actual or average number of pages in each project at each base must be known. An attempt was made to use an average size of specification. However, informal investigation revealed that the average size of specifications varied tremendously from base to base. Since the results of Eqs (2.1) and (2.2) are extremely sensitive to the value of (P), an overall Air Force average applied to each base would be impractical and meaningless. However, in order to demonstrate the procedure an attempt was made to determine an average value for the number of pages in an average base level specification. A small survey of Air Force design engineers attending two continuing education short courses was performed by the Air Force Institute of Technology, Civil Engineering School. Sixteen design engineers were asked what was the smallest, largest, and most frequent size of specification at their base. Three AFIT Civil Engineering instructors, each having extensive experience with specifications, also contributed their estimates for a total of 19 respondents. Replies ranged from 1 to 20 as the size of the smallest specification to 15 to 300 as the size of the largest specification, with the most frequent size ranging from 4 to 60 pages. These figures indicated a skewed distribution and comfirmed the variability of specification size from base to base. In order to determine an average for the number of pages of specifications in a typical project a Beta

distribution was assumed for the size of project specifications for each base. The formula

$$Z = \frac{a + 4m + b}{6}$$

where

a = pessimistic value (smallest specification)

m = most likely (most frequent specification)

b = optimistic value (largest specification)

was used to determine the expected size of specification for the sample bases responding. This estimation resulted in an expected or average specification size of 35 pages, with a standard deviation, $\sigma = \frac{b - a}{6} = 17$. These values will be used in further computations.

Additionally, the percent of actual design time an engineer spends preparing specifications is required in order to compute the portion of the engineer's salary pertaining to the time he spent reviewing and proofreading specifications after they have been typed. The percent of design time an engineer spends preparing specifications was not determined by the survey nor from any published sources reviewed. This information is again needed to demonstrate the procedure outlined by Eqs (2.1) and (2.2). An estimate for this value was obtained from the same AFIT Engineering School survey as mentioned previously; however, a normal

distribution was assumed for the engineers' responses. A simple average of the responses resulted in an average of 30 percent of an engineer's design time spent preparing specifications, with a standard deviation of 15 percent.

Development of Equation Parameters

The two values, average specification size and percent of an engineer's design time spent preparing specifications were, by necessity, estimated in order to demonstrate the procedure. The remaining parameters were computed as follows:

$$CPP = \frac{(E \times SE) + (R \times T \times ST) + EC}{P} \qquad (2.1)$$

E = the number of engineers in the design section, determined from the survey results.

R = 2 if comparing manual typing to any other method, 1 otherwise. This accounts for having to retype everything at least once using the manual typing method.

SE = the portion of an engineer's salary spent reviewing and proofreading specifications after they have been typed, determined as follows:

Engineer Cost:

Mean salary scale GS-11 Step 4 = $18763/yr
Annual cost to government of retirement and benefit programs based on percent of base pay IAW Office of Management and Budget circular A-76 is 28.7%.
(.287)($18763) = 5385
Total Cost $24148

Results of HQ USAF Civil Engineering and Services Management Evaluation Team visits to 19 bases in 1975, 1976, and 1977 reveal that an average of 45 percent of an engineer's time is spent doing actual project design.

$\therefore$ Engineer's cost for design =

(.45)($24148) = $10867

The estimate for percent of an engineer's design time spent preparing specifications, as determined earlier, is 30 percent.

$\therefore$ Engineer's cost for preparing specifications =

(.30)($10867) = $ 3260

From a CERL report, the percent of an engineer's specification preparation time that is spent reviewing and proofreading manual typed specifications is 40 percent (11:12).

$\therefore$ SE = (.40)($3260) = $1304/engineer/year reviewing and proofreading specifications.

ST, Typist's Costs:

Mean salary scale GS-4	Step 4 =	$ 9147
Annual cost to government of retirement and benefit based on percent of base pay IAW OMB circular A-76 = (.287)($9147)	=	2625
Total Cost		$11772

EC, Equipment Costs:

Computed from current GSA price schedule

Electric typewriter: IBM Selectric. Yearly cost computed based on $800 purchase price, 10 percent discount factor, and 5 year life

(replacement after 5 years).
Annual cost = 800 (crf, 10%, 5 years)
= 800 (.16275) = $130.20
→ use $130/year

Automatic typing equipment: GSA contract #GS-00S-06544

IBM MagCard II $310/mo x 12 =	$3720
Maintenance charges $40.74/mo x 12 =	489
Years supply of magnetic cards-- 1000 @ $.32 =	320
Total amount cost/yr =	$4529

Computer tie in with terminal/printer:
GSA contract #GS-09S-37414

Gen-Com Systems Inc Mod 300T	$ 1980
Maint costs after first 90 days	180
Communication line: Assume that a dedicated Wide Area Telecommunications System (WATS) line will be used. Computer central site will be Wash. D.C. to remainder of country is $1675/mo x 12 mos =	20100
Installation fee is $55 and will be ignored	
Total cost for computer tie in/yr =	$22260

A user's cost for computer time should also be included. However, investigation revealed that users cost was extremely variable depending on connect time, volume, and type of system the Army maintains. In this light even an estimate was not deemed practical.

P, Number of Pages of Specifications:

The number of projects for each base was determined by the survey. The average size of specification was estimated at 35 pages as explained earlier.

T, Number of Typists Devoted to Specifications:

The number of typists devoted to specifications was determined from the manning documents (UDL) received for each base. The criteria for determining the number of typists devoted to specifications was as indicated in Chapter II.

The parameters for Eq (2.2)

$$RNP = \frac{(E \times SE \times RFE) + (R \times T \times ST \times RFT) + EC}{CPP}$$

were computed as follows:

RNP = required number of pages to be produced to break even

E, SE, T, R, ST, and EC were determined in the same manner as for Eq (2.1)

RFE, reduction factor for engineers, was determined from a CERL report as follows (11:12):

Savings in engineer review and proofreading time when using automatic equipment as compared to manual typing is 78 percent.

$\therefore$ RFE for automatic typing equipment = .22

Savings in engineer review and proofreading time when using computer remote terminal/printer as compared to manual typing is 91 percent.

$\therefore$ RFE for computer equipment over manual equipment = .09

Savings in engineer review and proofreading time when using computer terminal/printer as compared to automatic typing equipment is 59 percent.

$\therefore$ RFE for computer equipment over automatic typing equipment = .41

RFT, reduction factor for typists was determined from a CERL report (11:11):

> Savings in typing, review, and revision time for automatic typing equipment over manual typing equipment is 39 percent.
>
> $\therefore$ RFT for automatic typing equipment over manual typing = .61
>
> Savings in typing, review, and revision time for computer remote terminal/computer tie-in over manual typing is 72 percent.
>
> $\therefore$ RFT for computer remote terminal/printer over manual typing = .28
>
> Savings in typing, review, and revision time for computer remote terminal/printer tie-in over automatic typing equipment is 46 percent.
>
> $\therefore$ RFT for computer remote terminal/printer over automatic typing equipment = .54

Example Problem

As stated previously, the survey did not provide the detailed data required to determine the specification preparation method most appropriate for each unit. However, in order to demonstrate how the procedure can be utilized by a base level engineering unit a typical size base will be assumed. The following example for automatic typing equipment will demonstrate the initial investigation computations using Eqs (2.1) and (2.2), and the additional

justification steps required by Air Force Manual 67-1 (23:18-25). This entire base level procedure is provided in detail in Appendix E, and will only be demonstrated here.

For the purposes of this example, the parameters for this typical base are: a) 12 design engineers, average grade GS-11, step 4; b) 1.2 typists devoted to specifications determined by office survey, average grade GS-4, step 4; c) existing equipment is electric manual typewriters; d) 75 projects designed per year, with an average size of 35 pages per project; e) results from extensive survey of engineering and construction branch total typing load yields 525 lines of typing per day; f) IBM MagCard II automatic typing equipment will be requested.

Using Eq (2.1) and the values previously computed for SE ($1304), ST ($11772), and EC ($130) yields the following cost per page (CPP).

$$CPP = \frac{(E \times SE) + (R \times T \times ST) + EC}{P}$$

$$CPP = \frac{(12 \times 1304) + (2 \times 1.2 \times 11772) + (130)(2)}{(75)(35)}$$

CPP = $16.82/page of specification produced.

The required number of pages of specifications necessary to be produced with automatic typing equipment to break even

costwise with the manual method is determined from the results of Eq (2.1) above and Eq (2.2). For this computation automatic typing equipment is used. The values for EC ($4529), RFE (.22), and RFT (.61) are as previously computed for automatic typing equipment.

$$RNP = \frac{(ExSExRFE) + (RxTxSTxRFT) + EC}{CPP}$$

$$RNP = \frac{(12x1304x.22) + (2x1.2x11772x.61) + (4529+130)}{16.82}$$

RNP = 1506 pages/year

This result indicates that the unit need only produce 1506 pages of specifications per year in order to pay for the cost of using automatic typing equipment. If the sample year is a typical year the cost per page will be reduced from $16.82/page to $9.65/page, a substantial savings. Assuming the same number of pages of specifications will be produced from year to year the yearly savings will be

($16.82/page)(75 projects)(35 pages/project)

- ($9.65/page)(75 projects)(35 pages/project)

= $18,821.

To determine the number of automatic typewriters required to satisfy the given workload of 525 lines per day; first, multiply the daily average by 20.99, the number of monthly workdays (15), (525 lines/day)(20.99 workdays/month)

= 11020 lines/month; second, convert lines per month to mandays by dividing by the expected machine performance factor for mixed typing using automatic typing equipment of 700 lines/day, 11020 lines/month ÷ 700 lines/day = 15.74 mandays/month; third, convert mandays/month to number of typists and thus automatic typewriters required to accomplish the workload by dividing by the number of productive mandays/month available per typist (15), (15.74 mandays/month) ÷ (16.5 mandays/month/typists) = .954 typists and automatic typewriters required.

To determine the overall savings as a result of converting to automatic typing equipment add the savings in engineers' salary resulting only from reduced review and proofreading time to specifications and the savings in typists' salary as a result of using automatic typing equipment, and then subtract the equipment costs.

(.78)(E)(SE) + (.39)(T)(ST) - EC

(.78)(12)($1304) + (.39)(2)(1.2)(11772) - (4529 - 130)

= $18825/year

Note that the cost of one manual typewriter is being saved. The difference between the above savings and the $18,821 computed previously is due to rounding.

Although this savings is not a capital savings, unless typist positions can be eliminated, it does accurately reflect a substantial savings in manhours. Using the

example, and attributing one-half of the cost of equipment against engineer savings yields (.78)(12)(1304) - .5(4529 - 130) = $10,006 savings. When using an average GS-11, step 4 hourly rate including retirement and health benefits of $11.61, the resulting savings is 1109 engineering manhours. These manhours can then be reallocated to more important engineering design work rather than the mundane task of reviewing and proofreading typing.

An example using the computer based method of producing specifications will not be shown. The number of unknown variables regarding the outcome of the Army's RPMA specifications in conjunction with their EDITSPEC program make this determination impractical. Unknowns at this time include: the final determination of whether the RPMA specifications will be computerized; the location and type of the central computer; the mode of operation, contract or service operated which will determine user and connect time costs; the variable communications costs depending on computer and base location and method of communicating; and, the type of remote terminal equipment required. All of these variables will remain unknown until the OCE decision is made and the system established. Only then can the Air Force develop its requirements to utilize the system. Additionally, AFM 300-6 and AFM 300-12 require detailed information of the type listed above before any action can be initiated

to use the Army's computer based specification system (16, 21). Any further investigation into this area is beyond the scope of this paper. However, the investigative procedure outlined in Eqs (2.1) and (2.2), as applied to computer equipment (using the appropriate reduction factors developed), remains valid and, once the equipment, communication, and user costs are known, can be applied.

CHAPTER V

ANALYSIS, CONCLUSIONS, AND RECOMMENDATIONS

Analysis and Conclusions

In this section, the results of the survey presented in Chapter III will be analyzed in light of the economic analysis performed in Chapter IV. The conclusions reached from the analysis of the data gathered and presented will then be stated.

Manning

The data gathered from the survey indicate that there are only 19 of the 71 design sections which responded which are fully manned. As can be seen from Table 3.1a, the assigned versus authorized manning in the design sections when grouped by major command, ranges from 79 percent to 94 percent. Although the information gathered does not indicate whether the vacant positions are engineer or technician positions, it is reasonable to conclude that many of the vacancies are engineer positions. The reduced design section manning seemingly throughout all major commands leads to the conclusion that the installation of any labor saving devices which can be employed to make the preparation of contractural documents more efficient,

such as automatic typewriter/master specification systems or computerized text manipulation systems, should be encouraged.

Methods of Specification Preparation

The survey response indicated that 40 percent of all project specifications prepared by Air Force design sections were prepared by the cut and paste method. As expected, this was the method most frequently used. The next most frequently used method was the production of project specifications from Corps of Engineers Construction Guide Specifications. This method accounted for 24 percent of project specifications. An additional 21 percent of the projects are prepared using locally produced master specification files. About one-half of that 21 percent is processed via automatic typing machines. Thus a total of 85 percent of the project specifications prepared by Air Force design sections use some form of master specification file. This indicates that many engineers are individually seeking more efficient methods of preparing project specifications. Results of the survey indicated that there are no command wide project specifications available; therefore, each base design office must assemble and prepare its own specification file. The 10 percent of the projects prepared with a master file and automatic typewriter further indicates the desires of design personnel to automate their methods.

The Corps of Engineers Construction Guide Specifications are designed to be used for new construction projects, and as such they do not lend themselves readily to maintenance and repair projects. Since the use of the Corps Guide Specifications accounts for the second highest method of producing specifications reported, it can be concluded that the design engineers are familiar with that specification file and use it whenever possible. This leads to the further conclusion that the RPMA Guide Specification file will be readily accepted by engineers throughout the Air Force and used to the maximum extent possible.

It is difficult to understand why engineers in Air Force design sections continue to prepare such a high percentage of their project specifications from scratch, especially maintenance, repair, and alteration projects. There may have been some misinterpretation of this method, but the definition as stated on the questionnaire and in Chapter I seems rather explicit. At first, 15 percent overall rate does not sound excessive; however, the 36 percent reported by ADCOM and the 24 percent reported by AFLC do seem questionable.

Equipment Availability

The survey questions were structured to gain information about the equipment available in the base design sections or accessible to that design section which could

be used to store or process a master guide specification file. As such, the questions concerned the availability or access to microfilm libraries containing the Federal Construction Regulations and the associated reader/printer equipment, automatic typing equipment using either a magnetic tape or card medium, and access to computer programs for the solution of engineering problems.

The response showed that 69 of the 71 base design sections which returned the questionnaire did possess microfilm libraries and reader/printer equipment. Since the use of this information storage and retrieval system is so widespread, it is concluded that it should form the basis for any method of preparing specifications which a particular design section might use. As mentioned in Chapter I, the RPMA Guide Specifications are divided into four parts, the deficiency checklist, the unit price schedule, the basic and specialized portions of the specification with notes to the designer, and the two-column format guide specification. The entire RPMA file will be stored in the microfilm library for reference where it will be updated by the commercial firm which markets the library whenever changes are made to the master file. Since the revisions which are made to the master file will be reported to the base design offices via revised microfilm libraries, a system will be required to update the magnetic cards or tape to reflect these same changes; otherwise, the magnetic file will soon

be outdated even though the master file and the microfilm file are current. Whenever any portion of the specification is needed for a project design, the appropriate portion can be displayed on the equipment and a working copy obtained simply by pushing a button. The engineer can then edit the text as appropriate, add or delete special provisions as necessary, and submit the edited copy for processing. The copy can then be typed manually, from magnetic cards or tape on an automatic typewriter, or from a computerized text editing system.

The use of computer systems is quite common in the Air Force. Each major command has access to a rather extensive computer system and practically every base has the Burroughs 3500 as a minimum computer system installed. In spite of this rather extensive proliferation of computer hardware and its associated software, only eleven base design offices reported that they had access to any computer software. Seven of the eleven bases are either in AFLC or AFSC. Both of these commands possess rather extensive computer hardware and software. AFLC has formally advised the design offices within its command of the existence and context of the programs available and has encouraged their use. It can only be concluded that the remaining four design offices which have gained access to computerized systems have done so only through the individual effort of some

person in that office. One response indicated that the only use of computer programs by that office was for preparation of a project design schedule.

Although there are a number of programs available in the Air Force which can solve many types of engineering problems, it appears that there has been very little effort directed toward informing the engineers at the base design offices of the existence of these programs or providing access to them through the major command. Included among the programs are text editing programs which can also be used for the production of project specifications if the master specification were stored on that program. A partial list of the programs which are available is included as Appendix D.

Automatic typewriters have been in existence for a number of years, and numerous studies cited earlier in this thesis have concluded that these machines are best suited for typing repetitive material which only requires text editing and slight modification to conform to a particular circumstance. Specifications for the maintenance and repair of real property facilities which are used at every Air Force base certainly fall into this category. However, the number of automatic typewriters in use at base design offices is minimal to say the least. It can only be concluded that the benefits which can be derived through the

use of equipment such as the magnetic medium automatic typewriter at the base level design offices have not been recognized at appropriate levels in the Air Force engineering hierarchy. It appears that there has been little or no emphasis placed on the acquisition of this equipment in order to assist the engineering staffs at the base design offices in preparing specifications.

When the responses which were received from major commands were reviewed to ascertain the extent of guidance which is being provided to the design offices within their jurisdiction, there was no evidence of any guidance or even information concerning the use of computer programs for engineering applications or the benefits of automatic typing equipment for specification preparation. This lack of such guidance or information supports the conclusions drawn above that there has been no guidance which would tend to imply command support of automation for the design offices.

Finally, the extensive review of both published and unpublished literature which is listed in the bibliography in both the governmental and private sectors of the engineering community, overwhelmingly support the thesis that repetitive typing requirements and master specifications are most efficiently and effectively processed through the use of automated equipment, whether that equipment be magnetic media automatic typing equipment or a computerized text

editing/manipulation system. The economic analysis performed in Chapter IV concluded that each Air Force design office should perform the analysis outlined in Appendix E in order to determine its workload and analyze its operation as a basis for requesting and receiving approval for the installation of automatic typing equipment.

Summary

In 1975, the Office of the Chief of Engineers, U.S. Army, directed the Corps of Engineers Construction Engineering Research Laboratory (CERL) to begin development of a comprehensive set of construction guide specifications for the maintenance, repair, and alteration of real property facilities (1:8). To date, over $1.5 million has been expended for the production of specifications for 42 of the 65 broad topic areas initially established. Guide specifications for the first 42 topics will be ready for distribution in February 1978. This master guide specification has been named the Real Property Maintenance Activity (RPMA) Guide Specification (8).

Extensive research in both the military and private sectors of the engineering community has indicated that the most efficient manner in which to process a master specification is by automated means. Automated means refers to editing and manipulating text using automatic typewriters which are operated from prerecorded magnetic tape or cards,

or using a computer based text editing program (7:30). The survey taken in conjunction with this thesis effort revealed that 85 percent of the project specifications prepared by Air Force base level design sections are prepared from some sort of prepared file. The prepared specification files range from copies of specifications prepared by the designer for previous similar projects, Corps of Engineers Construction Guide Specifications, to locally produced master specifications. It is evident that there is a widespread desire to use some sort of master specification system throughout the Air Force. Since no specific master specification file exists for maintenance, repair, and alteration of existing facilities, each design section, or in some cases each engineer, is attempting to create his own file. This trend toward a master specification file leads to the conclusion that the RPMA Guide Specification will be well received and used extensively by the base level design sections.

In spite of the widespread use of "master" specifications, the survey showed that only 19 base design sections have automatic typing equipment. Eleven design sections reported that they have access to computer programs, but none reported the use of text editing programs for producing their specifications. The survey results indicated that only 10 percent of the specifications

prepared by Air Force design sections were prepared on automatic typing equipment.

An economic analysis showed that the average size Air Force design section could economically justify the relatively large annual expenditure of funds necessary to acquire an automatic typewriter by preparing only one-half of the number of pages of specifications it now prepares annually. The analysis was performed for an example base design section consisting of 12 engineers, 1.2 typists devoted to typing specifications, and approximately 2600 pages of specifications prepared per year. Analysis revealed that the savings in engineer and typist manhours resulting from the use of automatic typing equipment would exceed $18,000. Although this will not be a capital savings in most cases, i.e., engineer and typist positions will not be eliminated, the manhours saved can be utilized for other necessary design work or other work requiring the services of a professional engineer. However, in those cases where more than two typists are devoted to typing specifications the elimination of one position may be realized. A procedure for justifying automatic typing equipment is included as Appendix E.

OCE is considering the option of maintaining the RPMA Guide Specifications on a specification text editing program called EDITSPEC (8). Air Force base level design

units may eventually have access to this system via computer remote terminals. However, until the OCE decision is made concerning the location of the central computer, its mode of operation (contract or government operated), and the user fees have been determined, an investigation into the economic feasibility of tying into such a system should not be considered. As a result, this aspect was not considered in this thesis.

The survey data also showed that 97 percent of the design sections possess microfilm libraries and the associated reader/printer equipment. The libraries include the Federal Construction Regulations (FCR) which contain military guide specifications. Informal discussions with representatives of one of the firms which market the libraries indicate that the RPMA Guide Specifications will become a part of the FCR library when they are available. Since the microfilm libraries are being used almost entirely throughout the design sections, they should become the basis for any method of specification preparation which is adopted at a particular base. The use of these libraries would insure that as long as the master specification file is kept up to date, the base files would also be updated automatically.

A survey of the major command Engineering and Construction Divisions revealed an extensive library of engineering computer programs at one major command, AFLC, with

virtually none available at the remaining major commands. These engineering programs are used by the AFLC base level engineering design units. It appears that the other major commands and bases either are not aware these programs exist or do not have the equipment available to make use of them. A listing of the AFLC engineering computer programs that can be made available to other Air Force agencies is given in Appendix D. Although these programs are for solving engineering problems, their use may be the first step for engineering design units becoming accustomed to interfacing with computer programs, which may eventually lead to a computer based specification text editing system.

Recommendations

The recommendations made in this section will be based upon the conclusions which were drawn from the data gathered in the surveys of the base level engineering design sections and of the major command Engineering and Construction Branches, in conjunction with the economic analysis of the use of automated equipment by the design sections. The recommendations are aimed at encouraging the concerted effort of all levels of command within the Air Force engineering community to establish the guidance and coordination necessary to justify and acquire more modern, automated methods of preparing project specifications. If followed, the recommendations should result in actual

capital savings in some instances where clerical positions could be eliminated, and most certainly in reducing the amount of time a project engineer must spend preparing specifications. The recommendations take on double emphasis in light of the adoption of the RPMA Guide Specifications which will be available for use at all Air Force installations in calendar year 1978. With the adoption of this master specification, the individual bases or major commands will be relieved of the burden of preparing their own master specification file which, as stated previously, is the most expensive part of an automated system. Recommendations will also be made which highlight related areas of research which were not within the scope of this thesis.

Recommendations for Automated Methods of Preparing Specifications

A. All levels of the Air Force engineering community should recognize that the use of automated methods of processing project specifications can result in capital savings in many instances and most certainly in time savings for project engineers.

B. Guidelines should be established for the base level design sections to justify and request automatic typing equipment for the preparation of project specifications.

C. Procedures for obtaining automatic typing equipment for the design sections should be established and coordinated at all levels of approval including logistics, administrative, and engineering functions.

D. Each base level engineering design section should be directed to perform the study required by Air Force regulations to initiate a request for automatic typing equipment.

E. Guidelines should be established to insure that the use of the RPMA Guide Specification is fully integrated with the use of automatic typing equipment.

F. Each design section should be directed to obtain the appropriate commercial microfilm technical libraries and associated reader/printer.

Recommendations for Research in Related Areas

A. During the course of the research, a number of computer programs were discovered in an HQ AFLC Civil Engineering library which were designed to perform engineering calculations and to manipulate text. A list of these programs and instructions for their use apparently has been distributed to the AFLC base design sections because four of the seven bases acknowledged access to them. AFLC and AFSC were the only major commands which reported any computer programs available; however, the AFSC program list was extracted from the AFLC list. There is a wealth of

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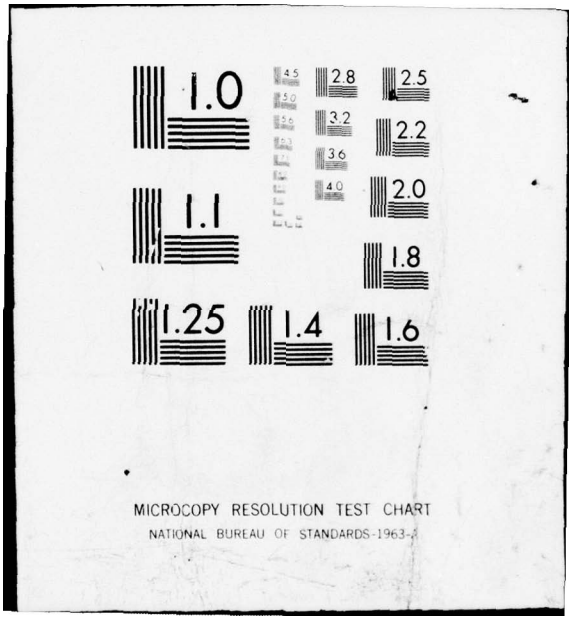
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MICROCOPY RESOLUTION TEST CHART
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information and knowledge available in the AFLC program library, and most of it is easily useable. It is therefor recommended that a study be performed to determine whether the computer equipment and program storage space exist at all of the main commands to use these programs and to make them available to the base design offices.

B. Once the automatic typing equipment is justified, it is imperative that guidelines be developed for it use in order to obtain maximum utilization. These guidelines should be specifically oriented toward the preparati of project specifications and related documents.

C. If automatic typewriters are used for the preparation of project specifications, each design section mus initially commit the master specification to a magnetic medium. Each time the master specification is revised, th magnetic medium must also be revised to stay current. In order to avoid the potential for out of date specification it is recommended that an investigation be initiated regarding the feasibility of mass producing magnetic cards and tapes from a central library for distribution to the using agencies.

D. It was noted earlier in the thesis that OCE plans to maintain the master copy of the RPMA Guide Specifications on a computer text editing file. If this plan i in fact carried out, it appears that design offices which produce a large volume of specifications may justify the

expense necessary to tie directly to that computer file and to access the text editing program through a time sharing system. However, the critical variables such as type of computer system, its location, mode of operation, communications costs, and user costs are all dependent on the Army decision. Detailed investigation into this area is impractical until this decision is made. Previous studies have shown, however, that potentially greater savings can be realized through the use of a computer based text editing program (11:12). In order to determine if the Air Force can take advantage of these savings, it is therefore recommended that this be a topic for further investigation into the area of automated specification preparation methods for Air Force base level engineering design sections.

APPENDIX A

SURVEY QUESTIONNAIRES

DEPARTMENT OF THE AIR FORCE
AIR FORCE INSTITUTE OF TECHNOLOGY (AU)
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

REPLY TO ATTN OF: SLGR (SLSR 21-77A/Capt Link/Capt Underwood/AUTOVON 78-74240)

SUBJECT: Engineering Design Survey RCS: AUN-EDV(OT) 77001

TO: DE

1. The attached survey was prepared by a research team at the Air Force Institute of Technology, Wright-Patterson AFB, Ohio. The purpose of the survey is to obtain information from you with respect to the size of your design section and the workload imposed on that section. The survey is also designed to determine which types of equipment for the preparation of contract specifications and storage/retrieval of information is available throughout the Air Force. The questions were constructed by the research team solely to conduct research for educational purposes.

2. Please remove this letter prior to returning the completed survey. Your cooperation in providing this data will be very beneficial in evaluating the need for finding a better method of preparing contract specifications at base level organizations. Please return the completed survey in the attached envelope within one week after receipt.

Henry W. Parlett

HENRY W. PARLETT, Colonel, USAF
Associate Dean for Graduate Education
School of Systems and Logistics

2 Atch
1. Survey
2. Return Envelope

SURVEY

For BCE Design Sections

1. Unit Designation_____

2. Major Command_____

3. Number of personnel in design section (Functional Account Code 4421).

   Authorized_____ Assigned_____

4. Number of engineers and engineering techicians whose primary duties include design of construction projects. (Construction projects include all categories, i.e., maintenance, repair, M.C., NAF, service, housing, etc.)

   Authorized_____ Assigned_____

5. Total number of projects designed during FY 75 (except service contracts).____

6. Total number of projects procured during FY 75 (except service contracts).____

7. Total dollar amount of all projects procured during FY 75 (except service contracts).

   Initial amount $_____

   Including modifications $_____

8. Total number of service contracts procured during FY 75 (i.e., custodial, trash collection, etc.)._____

9. Total dollar amount of service contracts procured during FY 75.

   Initial amount $_____

   Including modifications $_____

10. Total number of change orders processed against the projects procured in FY 75.

    Construction contracts_____

    Service contracts_____

RCS: AUN-EDV(OT) 77001

11. Does your office have access to any computerized programs for design or preparation of projects?

Yes No (Circle one)

12. If the answer to #11 is Yes, please attach a short description of each to this questionnaire.

13. Does your office possess a microfilm information storage/retrieval system such as Showcase or VSMF?

No Yes = Lease Own (Circle one)

14. If the answer to #13 is Yes, please specify the system.

_____

15. Does your office have access to automatic typing equipment such as the IBM MagCard II?

No Yes = Lease Own (Circle one)

16. If the answer to #15 is Yes, please specify the system plus any special features it has._____

_____

_____

17. What are the primary methods you use to prepare your specifications?

A. Individually write each entire specification--This refers to the process of a design engineer writing in long hand at least 75% of a complete specification and forwarding to an administrative clerk for typing.

_____%

B. Cut, paste, and edit old specifications--This refers to the process of reusing previously written specifications by cutting appropriate portions from them and pasting those portions together to form a new specification. Also includes rewriting or editing portions of that specification to fit the situation of concern. The final "pasted copy" is retyped in final form.

_____%

C. Assemble Corps of Engineers Guide Specifications to fit a project--This refers to the process of producing copies of Corps of Engineers Guide Specifications and assembling them in a logical order to

form the appropriate portions of a project specification. Copies are many times made from microfilm systems such as Showcase or VSMF.

_____%

D. Use local master specifications or guide specifications--This refers to the process of using in total or editing as appropriate locally produced standard specifications for certain projects. These are usually produced and used command wide.

_____%

E. Use automatic typing equipment to reproduce standard specifications--This refers to the use of automated typewriters such as IBM Selectric-MagCard II Systems. The specification is typed on magnetic tape or cards, indexed, and stored for future use. When a similar project must be prepared, the magnetic tape or cards are retrieved to reproduce the specification automatically. The engineer then edits the specification to fit the project and returns it for final reproduction.

_____%

F. Use computer based standard specifications--Refers to the use of any commercially available computer-based specification preparation system. The data base may be stored in computers used on the base, at the major air command or privately (or commercially) owned which are accessed via time sharing methods.

_____%

G. Any other method. Please describe._____

_____

_____

_____

_____

_____%

18. Who writes your specifications? Designer_____

Special Specification Writer_____

DEPARTMENT OF THE AIR FORCE
AIR FORCE INSTITUTE OF TECHNOLOGY (AU)
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

REPLY TO ATTN OF: SLGR (SLSR 21-77A/Capt Link/Capt Underwood/AUTOVON 78-74270)

SUBJECT: Engineering Design Survey RCS: AUN-EDV(OT) 77002 1 FEB 1977

TO: DEE

1. The attached survey was prepared by a research team at the Air Force Institute of Technology, Wright-Patterson AFB, Ohio. The purpose of the survey is to obtain information from you with respect to your command's policies concerning review of project plans and specifications, and additional design guidance which may have been developed within your command. The questions were constructed by the research team solely to conduct research for educational purposes.

2. Please remove this letter prior to returning the completed survey. Your cooperation in providing this data will be very beneficial in evaluating the uniformity of policy and guidance provided by the different commands in the field of construction project design. The ultimate goal of the study is to determine if there may be a need for a better method of preparing project specifications. A second survey has been attached to this letter for your information only. This survey has been sent to all civil engineering design sections in the Air Force except overseas. Please return the completed questionnaire in the attached envelope within one week after receipt.

Henry W. Parlett

HENRY W. PARLETT, Colonel, USAF
Associate Dean for Graduate Education
School of Systems and Logistics

3 Atch
1. Survey
2. Return Envelope
3. Sample Base Level Survey

SURVEY

FOR MAJOR COMMANDS

Major Command_____

1. How many engineers are on your staff whose responsibilities include reviewing plans and specifications for technical sufficiency for construction projects prepared by the bases within your command?_____

2. How many projects did your staff review for technical sufficiency during FY 1975?_____

3. Does your office have any computerized programs which solve engineering problems? (Either commercial, developed by your staff, or attained from other Air Force agencies.) Yes No (Circle one)

4. Are these programs available to the base design organizations in your command? Yes No (Circle one)

5. Has your command directed the use of any guide specifications or master specifications other than Corps of Engineers Guide Specifications at the bases within your command? Yes No (Circle one)

6. Please attach copies of the following documents when returning this questionnaire (If documents are not available, please so state):

   A. Current Command Supplement to AFR 89-1.
   B. Current Command Policy on funding of construction projects.
   C. Additional guidance for preparation of construction projects if different from your Supplement to AFR 89-1.
   D. Current directives to bases for the submission of their construction projects for technical review and approval.
   E. A list of the computerized programs available - (Reference question 3).
   F. A list of standard specifications available (Reference question 5).

RCS: AUN-EDV(OT) 77002

APPENDIX B

LIST OF RPMA GUIDE SPECIFICATION TOPIC AREAS

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TOPIC # 001     TRAFFIC CONTROL DEVICES                                  DEHAVEN
                    ELECTRICAL CONTROL SIGNALS                           0002000
                        32310   ELECTRICAL CONTROL SIGNALS, GENERAL
                    SIGNS                                                DEHAVEN
                        32320   SIGNS, GENERAL
                    PAVEMENT MARKING                                     DEHAVEN
                        32340   PAVEMENT MARKING, GENERAL

TOPIC # 002     SURFACED AREAS                                           DEHAVEN
                    OVERLAYS                                             DEHAVEN
                        32640   OVERLAYS, GENERAL
                        32641   ASPHALTIC CONCRETE OVERLAYS
                        32642   PORTLAND CEMENT CONCRETE OVERLAYS
                        32643   STEEL REINFORCED PCC OVERLAYS
                        32644   FIBROUS REINFORCED PCC OVERLAYS
                    REPAIR OF PCC PAVEMENTS                              DEHAVEN
                        32650   REPAIR OF PCC PAVEMENTS, GENERAL
                        32651   JOINT AND CRACK SEALING
                        32652   DEEP PATCHING
                        32653   SHALLOW PATCHING
                        32654   SLAB JACKING
                        32655   ASPHALT EMULSION SLURRY SEALS
                        32656   UNDERSEALING
                    REPAIR OF AC PAVEMENTS                               DEHAVEN
                        32660   REPAIR OF AC PAVEMENTS, GENERAL
                        32661   CRACK SEALING AC PAVEMENTS
                        32662   PATCHING OF AC PAVEMENTS
                        32663   SPRAY APPLICATIONS
                        32664   SLURRY SEALS

TOPIC # 003     SIDEWALKS                                                DEHAVEN
                    PORTLAND CEMENT CONCRETE SIDEWALKS                   DEHAVEN
                        32630   PORTLAND CEMENT CONCRETE SIDEWALKS

TOPIC # 004     BRIDGE INSPECTION                                        DEHAVEN
                    BRIDGE INSPECTION                                    DEHAVEN
                        61200   BRIDGE INSPECTION, GENERAL
                        61210   VEHICULAR BRIDGES
                        61220   RAILROAD BRIDGES
                        61230   PEDESTRIAN BRIDGES

TOPIC # 005     BRIDGE MAINTENANCE AND REPAIR                            DEHAVEN
                    BRIDGE M&R                                           DEHAVEN
                        32870   BRIDGE M&R, GENERAL
                        32871   PIERS, ABUTMENTS AND ANCHORS
                        32872   STEEL BRIDGES
                        32873   TIMBER BRIDGES
                        32874   CONCRETE BRIDGES
                        32875   MASONRY BRIDGES
                        32876   EXPANSION DEVICES AND ANCHORS
                        32877   GUARDRAILS
                        32878   STEEL GRATING BRIDGE DECKS
                        32879   PCC BRIDGE DECKS
                        32880   ASPHALTIC CONC. WEARING SURFACES
                        32881   LAND AND MARINE TRAFFIC CONTROLS
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TOPIC # 006     RAILROAD AND APPURTENANCES                              DEHAVEN
                TRACKAGE AND ACCESSORIES                                DEHAVEN
                     32850   TRACKAGE AND ACCESSORIES, GENERAL
                     32851   RAILROAD
                     32852   RAIL ACCESSORIES
                     32853   RAILROAD TIES
                     32854   TURNOUTS AND CROSSOVERS
                     32855   RAILROAD CROSSINGS
                     32856   GROUTING
                     32857   TIE, POLE AND PILE DRIVING
                     32858   BALLAST REPLACEMENT
                     32859   BALLAST CLEANING
                HIGHWAY CROSSING                                        DEHAVEN
                     32860   HIGHWAY CROSSING

TOPIC # 007     FENCES AND GATES                                        DEHAVEN
                FENCES AND GATES M&R                                    DEHAVEN
                     32710   FENCES AND GATES M&R, GENERAL
                     32711   GALVANIZED STEEL CHAIN LINK FENCING
                     32712   ALUMINIZED STEEL CHAIN LINK FENCING
                     32713   PLASTIC COATED STL CHAIN LINK FENCING
                     32714   STEEL ROD AND BAR FENCING
                     32715   WROUGHT IRON BAR FENCING
                     32716   PRECAST CONCRETE AND MASONRY FENCING
                     32717   PERMANENT WOOD FENCING
                     32718   SNOW AND OTHER TEMPORARY FENCING
                     32719   FARM-TYPE FENCING

TOPIC # 008     TRUSS INSPECTION                                        DEHAVEN
                TRUSS INSPECTION                                        DEHAVEN
                     61300   TRUSS INSPECTION, GENERAL
                     61310   WOOD TRUSS
                     61320   METAL TRUSS

TOPIC # 009     TRUSS MAINTAINANCE AND REPAIR                           DEHAVEN
                TRUSS M&R                                               DEHAVEN
                     43860   TRUSS M&R, GENERAL
                     43861   WOOD TRUSS
                     43862   METAL TRUSS
                TRUSS M&R                                               0002000
                     43875   TRUSS M&R, GENERAL
                     43876   WOOD TRUSS
                     43877   METAL TRUSS

TOPIC # 010     ROOF MAINTAINANCE AND REPAIR                            DEHAVEN
                PREP FOR REROOFING & REPAIR                             DEHAVEN
                     37001   PREP FOR REROOFING AND REPAIR, GENERAL
                     37002   WOOD DECK
                     37003   METAL DECK
                     37004   CONCRETE DECK
                     37005   GYPSUM DECKS
                VAPOR BARRIER FOR ROOFS                                 DEHAVEN
                     37191   VAPOR BARRIER FOR ROOFS, GENERAL
                     37192   BITUMINOUS
                     37193   LAMINATED SHEET
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37194 POLYVINYL SHEET

ROOF INSULATION AND UNDERLAYMENT DEHAVEN

37241 ROOF INSULATION AND UNDERLAYMENT, GENERAL
37243 CELLULAR GLASS
37244 MINERAL FIBER
37245 COMPOSITE BOARD
37246 EXPANDED PERLITE
37247 FIBERBOARD

SHINGLES AND ROOFING TILES DEHAVEN

37300 SHINGLES AND ROOFING TILES, GENERAL
37311 ASPHALT SHINGLES
37312 ASBESTOS-CEMENT SHINGLES
37313 WOOD SHINGLES AND SHAKES
37314 SLATE SHINGLES
37321 CLAY ROOFING TILES
37322 CONCRETE ROOFING TILES

PREFORMED ROOFING DEHAVEN

37400 PREFORMED ROOFING, GENERAL
37412 GALVANIZED PANELS
37413 ALUMINUM PANELS
37414 ALUMINIZED STEEL
37421 CORRUGATED ASBESTOS
37422 COMPOSITE
37423 PLASTIC PANELS

MEMBRANE ROOFING DEHAVEN

37500 MEMBRANE ROOFING, GENERAL
37511 MEMBRANE ROOFING - ASPHALT, BUILT-UP ORGANIC
37512 MEMBRANE ROOFING - ASPHALT, BUILT-UP, ASBESTOS
37513 MEMBRANE ROOFING - COAL-TAR PITCH, BUILT-UP
37514 MEMBRANE ROOFING - ASPHALT BUILT-UP, GLASS FIBER
37515 MEMBRANE ROOFING - COLD-PROCESSED BUILT-UP
37516 MEMBRANE ROOFING-INVERTED ROOFS
37520 PREPARED ROLL ROOFING
37530 ELASTIC SHEET ROOFING
37540 ELASTOMERIC FLUID-APPLIED ROOFING

TRAFFIC TOPPING FOR ROOFS DEHAVEN

37571 TRAFFIC TOPPING FOR ROOFS, GENERAL
37572 WOOD TRAFFIC TOPPING
37573 COMPOSITION TRAFFIC TOPPING
37574 PRECAST OR STONE TRAFFIC TOPPING

SHEET METAL FOR ROOFING DEHAVEN

37600 SHEET METAL FOR ROOFING, GENERAL
37601 FLASHING AND TRIM
37602 ROOF-RELATED SHEET METAL ACCESSORIES
37610 SHEET METAL

TOPIC # 011 WATERPROOFING AND DAMPPROOFING DEHAVEN

WATERPROOFING DEHAVEN

37100 WATERPROOFING M & R, GENERAL
37110 MEMBRANE WATERPROOFING
37111 TWO AND THREE-PLY BITUMINOUS MEMBRANES
37115 ELASTIC SHEET WATERPROOFING
37120 FLUID APPLIED WATERPROOFING
37123 METAL WATERPROOFING
37130 BENTONITE CLAY WATERPROOFING
37140 METAL OXIDE WATERPROOFING

DAMPPROOFING DEHAVEN

37150 DAMPPROOFING, GENERAL
37160 BITUMINOUS DAMPPROOFING
37170 SILICONE DAMPPROOFING
37175 WATER REPELLANT COATING DAMPPROOFING
37180 CEMENTITIOUS DAMPPROOFING
37196 BITUMINOUS VAPOR BARRIERS
37197 LAMINATED SHEET VAPOR BARRIERS
37198 PLASTIC SHEET VAPOR BARRIERS

TOPIC # 012 MASONRY RESTORATION DEHAVEN

MASONRY REPAIR AND REPLACEMENT DEHAVEN

34100 MASONRY REPAIR AND REPLACEMENT, GENERAL
34110 REPAIR AND REPLACEMENT OF DETERIORATED BRICKWORK
34120 REPAIR AND REPLACEMENT OF DETERIORATED STONEWORK
34130 REPAIR AND REPLACEMENT OF EXPOSED AGGREGATE SURFACE CONCRE
34140 REPAIR AND REPL. OF DETER. CONCRETE UNIT MASONRY
34150 REPAIR AND REPL. OF DETER. TILE (CERAMIC, GLASS)
34160 TERRA COTTA

MASONRY RESTORATION DEHAVEN

34500 MASONRY RESTORATION, GENERAL
34510 CLEANING
34520 REPOINTING AND TUCKPOINTING
34530 MASKING AND GROUTING

TOPIC # 013 INSULATION DEHAVEN

BUILDING INSULATION DEHAVEN

37210 BUILDING INSULATION, GENERAL
37211 BATT AND BLANKET INSULATION
37212 LOOSE FILL INSULATION
37213 RIGID INSULATION
37214 SPRAYED-ON AND FOAMED-IN-PLACE INSULATION

PERIMETER AND UNDER-SLAB INSULATION DEHAVEN

37250 PERIMETER AND UNDER-SLAB INSULATION

TOPIC # 014 DOORS AND WINDOWS DEHAVEN

HOLLOW METAL DOORS AND FRAMES DEHAVEN

38110 HOLLOW METAL DOORS AND FRAMES, GENERAL
38111 FULL FLUSH HOLLOW METAL DOORS

WOOD DOORS DEHAVEN

38210 WOOD DOORS, GENERAL
38211 SOLID CORE FLUSH WOOD DOORS WITH VENEER FACES
38212 SOLID CORE FLUSH WOOD DOORS WITH PLASTIC LAMINATE FACES
38213 HOLLOW CORE FLUSH WOOD DOORS WITH VENEER FACES
38214 HOLLOW CORE FLUSH WOOD DOORS WITH PLASTIC LAMINATE FACES
38215 HOLLOW CORE FLUSH WOOD DOORS WITH HARDBOARD FACES
38216 STILE AND RAIL PANEL WOOD DOORS
38217 LOUVERED WOOD DOORS

SLIDING FIRE DOORS DEHAVEN

38310 SLIDING FIRE DOORS, GENERAL
38311 COMPOSITE SLIDING FIRE DOORS
38312 HOLLOW METAL (SHEET METAL) SLIDING FIRE DOORS
38313 TIN-CLAD SLIDING FIRE DOORS
38314 HORIZONTAL SLIDING STEEL DOORS
38315 VERTICAL LIFT SLIDING STEEL DOORS
38320 METAL CLAD (KALAMEIN) DOORS

COILING (ROLLING) DOORS			DEHAVEN
	38330	COILING (ROLLING) DOORS, GENERAL	
	38331	ROLLING STEEL DOORS	
	38332	ROLLING WOOD DOORS	
	38336	ROLLING SHUTTERS	
FOLDING DOORS			DEHAVEN
	38340	FOLDING DOORS	
FLEXIBLE DOORS			DEHAVEN
	38350	FLEXIBLE DOORS	
OVERHEAD DOORS			DEHAVEN
	38360	OVERHEAD DOORS, GENERAL	
	38361	STEEL OVERHEAD DOORS	
	38362	WOOD OVERHEAD DOORS	
	38363	ALUMINUM OVERHEAD DOORS	
	38364	GLASS FIBER OVERHEAD DOORS	
SLIDING GLASS DOORS			DEHAVEN
	38370	SLIDING GLASS DOORS, GENERAL	
	38371	ALUMINUM SLIDING GLASS DOORS	
	38372	WOOD SLIDING GLASS DOORS	
SAFETY GLASS DOORS			DEHAVEN
	38375	SAFETY GLASS DOORS, GENERAL	
	38376	ALUMINUM SAFETY GLASS DOORS	
	38377	WOOD SAFETY GLASS DOORS	
SOUND RETARDANT DOORS			DEHAVEN
	38380	SOUND RETARDANT DOORS, GENERAL	
	38381	STEEL SOUND RETARDANT DOORS	
	38382	WOOD SOUND RETARDANT DOORS	
SCREEN AND STORM DOORS			DEHAVEN
	38390	SCREEN AND STORM DOORS, GENERAL	
	38391	ALUMINUM SCREEN DOORS	
	38392	WOOD SCREEN DOORS	
	38394	WOOD STORM DOORS	
	38395	ALUMINUM COMBINATION SCREEN AND STORM DOORS	
	38396	WOOD COMBINATION SCREEN AND STORM DOORS	
	39393	ALUMINUM STORM DOORS	
ENTRANCES			DEHAVEN
	38400	ENTRANCES	
REVOLVING DOORS			DEHAVEN
	38450	REVOLVING DOORS	
STEEL WINDOWS			DEHAVEN
	38510	STEEL WINDOWS, GENERAL	
	38511	FIXED STEEL WINDOWS W/HOPPER VENT	
	38512	FIXED STEEL WINDOWS	
	38513	PROJECTED STEEL WINDOWS	
	38514	CONTINUOUS TOP HINGED WINDOWS	
	38515	CASEMENT WINDOWS	
	38516	AWNING WINDOWS	
	38517	REVERSIBLE WINDOWS	
	38518	HINGED EMERGENCY WINDOWS	
	38519	DOUBLE/SINGLE HUNG WINDOWS	
ALUMINUM WINDOWS			DEHAVEN
	38520	ALUMINUM WINDOWS, GENERAL	
	38521	FIXED WINDOWS	
	38522	PROJECTED WINDOWS	
	38523	CASEMENT WINDOWS	
	38524	AWNING WINDOWS	

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                    38525   REVERSIBLE WINDOWS
                    38526   HINGED ACCESS WINDOWS
                    38527   DOUBLE/SINGLE HUNG WINDOWS
                    38528   DOUBLE/SINGLE/TRIPLE HUNG WINDOWS
                    38529   HORIZONTAL SLIDING WINDOWS
               STAINLESS STEEL, BRONZE AND PLASTIC WINDOWS    0002000
                    38530   STAINLESS STEEL WINDOWS
                    38541   PLASTIC WINDOWS (ACTUALLY 38620)
                    38540   BRONZE WINDOWS
               WOOD WINDOWS                                   DEHAVEN
                    38610   WOOD WINDOWS, GENERAL
                    38612   AWNING, HOPPER AND CASEMENT WINDOWS
                    38614   SINGLE AND DOUBLE HUNG WINDOWS
                    38616   HORIZONTAL SLIDING WINDOW UNITS
                    38618   FIXED WINDOW UNITS
               FIN. HARDWARE,WEATHERSTRIPPING,SEALS,THRESHOLD 0002000
                    38718   WEATHERSTRIPPING AND SEALS (ACTUALLY 38730)
                    38719   THRESHOLDS (ACTUALLY 38740)
                    38710   FINISH HARDWARE, GENERAL
                    38711   LOCKS, LOCKSETS, LATCHSETS
                    38713   EXIT, PANIC HARDWARE
                    38715   BUTTS, HINGES, CLOSURES AND FLOOR CHECKS
                    38717   MISCELLANEOUS HARDWARE FOR DOORS & WINDOWS
               DOOR AND WINDOW OPERATORS                      DEHAVEN
                    38720   DOOR OPERATORS, GENERAL
                    38721   AUTOMATIC DOOR CONTROLS
                    38722   AUTOMATIC DOOR OPERATORS
                    38723   WINDOW OPERATORS
               GLASS AND GLAZING                              DEHAVEN
                    38800   GLASS & GLAZING,GENERAL
                    38811   PLATE GLASS
                    38812   SHEET GLASS
                    38813   TEMPERED GLASS
                    38814   WIRED GLASS
                    38815   ROUGH AND FIGURED GLASS
                    38822   LAMINATED GLASS
                    38823   INSULATING GLASS
                    38830   MIRROR GLASS
                    38840   GLAZING PLASTICS
                    38845   BULLET-RESISTING GLASS
                    38846   ONE-WAY VISION GLASS

TOPIC # 015    PLASTERING AND WALLBOARD REPAIR                  DEHAVEN
               PLASTER REPAIRS                                  DEHAVEN
                    39110   PLASTER REPAIRS, GENERAL
               WALLBOARD REPAIRS                                DEHAVEN
                    39210   WALLBOARD REPAIRS, GENERAL
                    39211   GYPSUM WALLBOARD
                    39212   PLYWOOD WALLBOARD

TOPIC # 016    FLOORS                                           DEHAVEN
               CERAMIC TILE                                     DEHAVEN
                    39310   CERAMIC TILE, GENERAL
                    39320   CERAMIC MOSAICS
                    39321   CONDUCTIVE CERAMIC TILE
                    39330   QUARRY TILE
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                39331   ACID RESISTANT QUARRY TILE
          TERRAZZO FLOORS                                          DEHAVEN
                39400   TERRAZZO FLOORS, GENERAL
                39410   PORTLAND CEMENT TERRAZZO
                39420   PRECAST TERRAZZO
                39430   CONDUCTIVE TERRAZZO
                39431   CONDUCTIVE RESINOUS TERRAZZO
                39432   CONDUCTIVE SPARKPROOF RESINOUS TERRAZZO
                39440   PLASTIC MATRIX TERRAZZO
                39445   RESINOUS TERRAZZO
          WOOD FLOORS                                              DEHAVEN
                39550   WOOD FLOORS, GENERAL
                39560   WOOD STRIP FLOORS
                39570   GYMNASIUM-TYPE HARDWOOD STRIP FLOORS
                39575   GYMNASIUM-TYPE STEEL-SPLINED HARDWOOD FLOORS
                39610   WOOD PARQUET FLOORS
                39620   SOFTWOOD FLOORS
          RESILIENT FLOORS                                         DEHAVEN
                39650   RESILIENT FLOORS, GENERAL
                39651   CEMENTITIOUS UNDERLAYMENT
                39655   RESILIENT TILE FLOORS
                39656   RESILIENT SHEET FLOORS
                39675   CONDUCTIVE VINYL TILE
          CARPETING                                                DEHAVEN
                39680   CARPETING, GENERAL
                39681   CARPET CUSHION
                39682   CARPET
                39683   BONDED CUSHION CARPET
          SPECIAL FLOORS                                           DEHAVEN
                39700   SPECIAL FLOORS, GENERAL
                39710   MAGNESIUM OXYCHLORIDE FLOORS
                39730   CONDUCTIVE ELASTOMERIC LIQUID FLOORS
                39740   HEAVY-DUTY CONCRETE TOPPING
                39741   ARMORED FLOORS
                39750   BRICK FLOORS
          FLOOR TREATMENT                                          DEHAVEN
                39760   FLOOR TREATMENT, GENERAL
                39761   STANDARD TREATMENT
                39762   NON-SLIP FLOOR TREATMENT
                39780   WOOD FLOORS, REFINISHING

TOPIC # 017     PAINTING, INTERIOR                                       DEHAVEN
          INTERIOR PAINTING                                        DEHAVEN
                50200   INTERIOR PAINTING, GENERAL
                50210   CONCRETE AND MASONRY - GENERAL USE AREAS
                50211   CONCRETE AND MASONRY - HEAVY MAINTENANCE AREAS
                50212   CONCRETE AND MASONRY - FOOD PREPARATION, LAUNDRY AND LATRI
                50213   CONCRETE FLOORS, STEPS AND PLATFORMS
                50214   CONCRETE AND MASONRY - REFRIGERATED SPACES
                50220   PLASTER, GYPSUM BOARD, ABSESTOS CEMENT BOARD - GENERAL USE
                50221   PLASTER, GYPSUM BOARD, ASBESTOS CEMENT BOARD - HEAVY MAINT
                50222   PLASTER, GYPSUM BOARD, ASBESTOS CEMENT BOARD - FOOD PREPAR
                50223   PLASTER, GYPSUM BOARD, ASBESTOS CEMENT BOARD - REFRIGERATE
                50230   FERROUS SURFACES - GENERAL USE AREAS
                50231   FERROUS SURFACES - CONCEALED DAMP SPACES
                50232   FERROUS SURFACES - MECHANICAL AND ELECTRICAL EQUIPMENT
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	50233	FERROUS SURFACES - REFRIGERATED SPACES	
	50234	FERROUS SURFACES - HIGH TEMPERATURE AREAS	
	50240	WOOD AND WOOD COMPOSITION - GENERAL USE AREAS	
	50241	WOOD AND WOOD COMPOSITION - HEAVY MAINTENANCE AREAS	
	50242	WOOD AND WOOD COMPOSITION - FLOORS, STEPS AND PLATFORMS	
	50250	WOOD (NATURAL FINISH) - GENERAL USE AREAS	
	50251	WOOD (NATURAL FINISH) - FLOORS (EXCEPT GYMNASIUM FLOORS)	
	50252	WOOD (NATURAL FINISH) - GYMNASIUM FLOORS	
	50253	WOOD (NATURAL FINISH) - SEATS AND PEWS	
	50260	MISCELLANEOUS SURFACES - ALUMINUM, ALUMINUM ALLOY, COPPER	
	50261	MISCELLANEOUS SURFACES - GALVANIZED METAL	
	50262	MISCELLANEOUS SURFACES - INSUL. PLANK & TILE ROOF DECKING	
	50263	MISCELLANEOUS SURFACES - COTTON,CANVAS & GLASS CLOTH COVER	
TOPIC # 018	WATER STORAGE TANK PAINTING		DEHAVEN
	WATER STORAGE TANK PAINTING		DEHAVEN
	50310	WATER STORAGE TANK, PAINTING - GENERAL	
	50311	WATER STORAGE TANK, PAINTING -EXTERIOR	
	50312	WATER STORAGE TANK, PAINTING -INTERIOR	
TOPIC # 019	PAINTING, EXTERIOR		DEHAVEN
	EXTERIOR PAINTING		DEHAVEN
	50100	EXTERIOR PAINTING, GENERAL	
	50110	CONCRETE AND MASONRY, STUCCO, CLAY TILE - GENERAL USE AREA	
	50111	CONCRETE FLOORS, STEPS, PLATFORMS	
	50112	ASBESTOS CEMENT BOARD	
	50113	CONCRETE WALLS AND FLOORS OF SWIMMING POOLS	
	50120	WOOD - GENERAL USE AREAS	
	50121	WOOD - STRIPS, PLATFORMS, FLOORS OF OPEN PORCHES	
	50122	WOOD - STAIN FINISH	
	50130	FERROUS SURFACES - GENERAL USE AREAS	
	50131	FERROUS SURFACES - MECHANICAL AND ELECTRICAL EQUIPMENT	
	50132	FERROUS SURFACES - HIGH TEMPRERATURE AREAS	
	50140	MISCELLANEOUS SURFACES - ALUMINUM, ALUMINUM ALLOY, COPPER	
	50141	MISCELLANEOUS SURFACES - GALVANIZED METAL	
TOPIC # 020	RESIDENTIAL ELECTRICAL EQUIPMENT		DEHAVEN
	RESIDENTIAL ELECTRICAL EQUIPMENT M&R		DEHAVEN
	41900	RESIDENTIAL ELECTRIC EQUIPMENT, GENERAL	
	41910	RANGES AND OVENS	
	41920	GARBAGE DISPOSALS	
	41930	REFRIGERATORS	
	41940	DISH WASHERS	
	41950	CLOTHES DRYERS	
	41960	CLOTHES WASHERS	
	41970	ATTIC AND EXHAUST FANS	
TOPIC # 021	BLEACHERS AND TRAINING FACILITIES		DEHAVEN
	BLEACHERS AND TRAINING FACILITIES		DEHAVEN
	42720	BLEACHERS, GENERAL	
	TRAINING FACILITIES		DEHAVEN
	43710	TRAINING FACILITIES, GENERAL	
	43711	FIRING RANGES	
TOPIC # 022	PLATFORM AND DOCK M&R		DEHAVEN
	PLATFORMS & DOCKS M&R		DEHAVEN

43900 PLATFORMS AND DOCKS M&R, GENERAL
43902 PLATFORM AND DOCK LEVELERS
43903 TIMBER DOCKS AND SUPPORTS
43904 STEEL SUPPORTS
43905 CONCRETE SUPPORTS
43907 RAMPS AND STAIRS
43908 LIFTS
43909 ENCLOSURES
43910 ASPHALT CONCRETE SURFACES
43911 PCC CONCRETE SURFACES
43913 WARNING DEVICES
43914 GUARD RAILS AND POSTS
43915 BUMPERS

TOPIC # 023 FOOD SERVICE EQUIPMENT DEHAVEN
FOOD SERVICE EQUIPMENT DEHAVEN
41400 FOOD SERVICE EQUIPMENT, GENERAL

TOPIC # 024 ELEVATOR MAINTENANCE AND REPAIR DEHAVEN
ELEVATOR M&R DEHAVEN
44210 ELEVATOR M & R, GENERAL
44211 HOISTWAYS
44212 DOOR LOCKING DEVICES
44213 ELECTRIC ELEVATOR CARS
44214 ELECTRIC ELEVATOR DRIVING MACHINES
44215 ELECTRIC ELEVATOR STOPPING DEVICES
44216 ELECTRIC ELEVATOR OPERATING DEVICES
44217 HOISTING ROPES
44218 HYDRAULIC ELEVATOR DRIVING MACHINES
44219 HYDRAULIC ELEVATOR STOPPING DEVICES
44220 HYDRAULIC ELEVATOR OPERATING DEVICES

TOPIC # 025 ELEVATOR INSPECTION DEHAVEN
ELEVATOR INSPECTION DEHAVEN
61430 ELEVATOR INSPECTION, GENERAL
61431 HOISTWAYS
61432 DOOR LOCKING DEVICES
61433 ELECTRIC ELEVATOR CARS
61434 ELECTRIC ELEVATOR DRIVING MACHINES
61435 ELECTRIC ELEVATOR STOPPING DEVICES
61436 ELECTRIC ELEVATOR OPERATING DEVICES
61437 HOISTING ROPES
61438 HYDRAULIC ELEVATOR DRIVING MACHINES
61439 HYDRAULIC ELEVATOR STOPPING DEVICES
61440 HYDRAULIC ELEVATOR OPERATING DEVICES

TOPIC # 026 HOSPITAL PNEUMATIC TUBE SYSTEM DEHAVEN
PNEUMATIC TUBE SYSTEM DEHAVEN
44710 PNEUMATIC TUBE SYSTEM, GENERAL
44711 VACUUM PUMP
44712 CARRIERS
44713 ELECTRICAL

TOPIC # 027 HVAC&R MAINTENANCE AND REPAIR DEHAVEN
RADIATORS DEHAVEN
46300 RADIATORS, GENERAL

	46310	CAST IRON	
	46320	BASEBOARD - FIN TUBE	
	46330	RADIANT	
	46340	CONVECTOR	
WARM AIR FURNACES			DEHAVEN
	46410	WARM AIR FURNACES, GENERAL	
	46411	GAS	
	46412	OIL	
	46413	ELECTRIC	
FANS			DEHAVEN
	46430	FANS, GENERAL	
	46431	CENTRIFUGAL	
	46432	AXIAL FLOW	
	46434	PROPELLER WALL EXHAUST	
	46435	CENTRIFUGAL WALL EXHAUST	
	46436	POWER ROOF VENTILATORS	
AIR HANDLING UNITS			DEHAVEN
	46440	AIR HANDLING UNITS, GENERAL	
	46441	UNITARY	
	46442	FACTORY FABRICATED	
	46443	FIELD FABRICATED	
DUCT AND ACCESSORIES			DEHAVEN
	46460	DUCT AND ACCESSORIES, GENERAL	
	46461	FILTERS	
	46462	REGISTERS, GRILLES AND DIFFUSERS	
	46465	HUMIDIFIERS	
	46466	CONTROL AND FIRE DAMPERS	
	46467	INSULATION	
COILS			DEHAVEN
	46610	COILS, GENERAL	
	46611	WATER	
	46612	DIRECT EXPANSION	
	46613	ELECTRICAL HEATING (AND HEAT STRIPS)	
	46614	STEAM	
CONDENSERS			DEHAVEN
	46640	CONDENSERS, GENERAL	
	46641	AIR COOLED - REPAIR	
	46642	WATER COOLED - REPAIR	
EVAPORATIVE COOLERS			DEHAVEN
	46645	EVAPORATIVE COOLERS, GENERAL	
COOLING TOWERS			DEHAVEN
	46670	COOLING TOWERS, GENERAL	
	46671	WOOD, NATURAL DRAFT	
	46672	METAL, NATURAL DRAFT	
	46673	GLASS FIBER, NATURAL DRAFT	
REFRIGERANT EQUIPMENT			DEHAVEN
	46680	REFRIGERANT EQUIPMENT, GENERAL	
	46681	RECIPROCATING	
	46682	CENTRIFUGAL	
	46683	ABSORPTION	
	46684	ROTARY SCREW	
UNIT HEATERS			DEHAVEN
	46720	UNIT HEATERS, GENERAL	
	46721	STEAM	
	46722	HOT WATER	
	46723	ELECTRIC	

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                    46724   GAS
                    46725   OIL
               CONTROLS                                        DEHAVEN
                    46800   CONTROLS, GENERAL
                    46810   PNEUMATIC
                    46820   ELECTRIC
                    46830   ELECTRONIC
                    46840   MANUAL
               COLD STORAGE FACILITIES                         DEHAVEN
                    46850   COLD STORAGE FACILITIES, GENERAL
                    46851   PANEL INSULATION
                    46851   FOAMED-IN-PLACE INSULATION

TOPIC # 028    CATHODIC PROTECTION OF STEEL WATER TANKS                DEHAVEN
               CATHODIC PROTECTION OF STEEL WATER TANKS        DEHAVEN
                    66120   CATHODIC PROTECTION OF STEEL WATER TANKS, GENERAL
                    66121   INSPECTION REQUIREMENTS - STEEL WATER TANKS
                    66122   REPAIR REQUIREMENTS - STEEL WATER TANKS
                    66123   MAINTENANCE AND OPERATING INSTRUCTIONS - STEEL WATER TANKS

TOPIC # 02?    CATHODIC PROTECTION FOR UNDERGROUND UTILITIES          0002000
               CATHODIC PROTECTION SYSTEMS FOR UNDERGROUND UT DEHAVEN
                    66110   CATHODIC PROTECTION SYSTEMS FOR UNDERGROUND UTILITIES
                    66111   INSPECTION REQUIREMENTS - SACRIFICIAL (GALVANIC) ANODE SYS
                    66112   INSPECTION REQUIREMENTS - IMPRESSED CURRENT SYSTEM
                    66113   REPAIR REQUIREMENTS - SACRIFICIAL (GALVANIC) ANODE SYSTEM
                    66114   REPAIR REQUIREMENTS - IMPRESSED CURRENT SYSTEM
                    66115   MAINTENANCE AND OPERATING INSTRUCTIONS - SACRIFICIAL (GALV
                    66116   MAINTENANCE AND OPERATING INSTRUCTIONS - IMPRESSED CURRENT

TOPIC # 030    WATER DISTRIBUTION SYSTEM M&R                          DEHAVEN
               INSTALLATION                                    DEHAVEN
                    45110   INSTALLATION, GENERAL
                    45111   HYDROSTATIC TESTING
                    45112   PNEUMATIC TESTING
                    45113   CONNECTIONS
                    45114   DISINFECTION
               ELEVATED STORAGE TANK                           DEHAVEN
                    45120   ELEVATED STORAGE TANKS, GENERAL
                    45121   STEEL TANK
               BELOW-GRADE STORAGE TANK                        DEHAVEN
                    45130   BELOW-GRADE STORAGE TANK, GENERAL
                    45131   CONCRETE TANK
               PNEUMATIC EQUIPMENT                             DEHAVEN
                    45140   PNEUMATIC EQUIPMENT, GENERAL
                    45141   PNEUMATIC TANK
                    45142   PRESSURE SWITCH
                    45143   SIGHT GLASS
               RESERVOIR                                       DEHAVEN
                    45150   RESERVOIR, GENERAL
                    45151   FLEXIBLE LINER AND COVER

TOPIC # 031    WATER TREATMENT PLANT M&R                              DEHAVEN
               INTAKE STRUCTURE                                DEHAVEN
                    49110   INTAKE STRUCTURE,GENERAL
                    49111   SCREEN
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49112	DEBRIS RACK	
49113	SILT REMOVAL	
CHEMICAL METERING EQUIPMENT		DEHAVEN
49140	CHEMICAL METERING EQUIPMENT, GENERAL	
49143	GAS INJECTORS	
49145	GAS EVAPORATORS	
ELECTRICAL CONTROLS AND INSTRUMENTATION		DEHAVEN
49150	ELECTRICAL CONTROLS AND INSTRUMENTATION, GENERAL	
49156	FLOW METERS	
49157	PH METER	
49158	THERMOMETER	
49159	ELECTRODES	
49160	CHLORINE ANALYZER	
FILTERS		DEHAVEN
49190	FILTERS, GENERAL	
49191	GRAVITY	
49192	PRESSURE	
49193	OVERFLOW WEIRS	
49194	SEQUENCE CONTROLS	
49195	BACKWASH EQUIPMENT	
49196	SOLENOID VALVES	
49197	CARBON FILTER MEDIA	
49198	SAND FILTER MEDIA	
49199	MIXED MEDIA FILTER	
SETTLING CHAMBER		DEHAVEN
49210	SETTLING CHAMBER, GENERAL	
49211	CLARIFIER RAKES	
49213	WEIR	
49214	SLUDGE CONVEYORS	
49215	CHAIN IDLERS	
49216	DRIVE EQUIPMENT	
MIXING CHAMBERS AND EQUIPMENT		DEHAVEN
49220	MIXING CHAMBERS AND EQUIPMENT, GENERAL	
49221	STATIC MIXERS	
49222	BAFFLES	
49223	AGITATOR	
49224	DRIVE EQUIPMENT	
CHLORINE CONTACT TANK		DEHAVEN
49230	CHLORINE CONTACT TANK, GENERAL	
DISINFECTION EQUIPMENT		DEHAVEN
49240	DISINFECTION EQUIPMENT, GENERAL	
49242	GAS INJECTOR	
49244	SOLUTION TANKS	
AERATION EQUIPMENT		DEHAVEN
49250	AERATION EQUIPMENT, GENERAL	
49251	TRAY	
49252	MEDIA	
CHEMICAL STORAGE EQUIPMENT		DEHAVEN
49330	CHEMICAL STORAGE EQUIPMENT, GENERAL	
49332	SOLUTION TANK	
49333	DRAIN	
49334	BIN	
49335	VIBRATORY FEEDER	
49336	CONVEYOR	
SCALES AND WEIGHING EQUIPMENT		DEHAVEN
49350	SCALES AND WEIGHING EQUIPMENT, GENERAL	

49351 LABORATORY SCALES
49352 BULK MATERIAL SCALES
49353 CHLORINE SCALES
BACKWASH EQUIPMENT DEHAVEN
49360 BACKWASH TANKS, GENERAL
IRON AND MANGANESE FILTERS DEHAVEN
49370 IRON AND MANGANESE FILTERS, GENERAL
49371 AERATION EQUIPMENT
49372 FILTER
SOFTENING DEHAVEN
49380 SOFTENING, GENERAL
49384 CHEMICAL STORAGE BINS
49385 SEDIMENTATION BASIN
ION EXCHANGE DEHAVEN
49390 ION EXCHANGE, GENERAL
49391 EXHANGE COLUMN
49392 FLOW CONTROLLERS
49393 SEQUENCE CONTROLS
49394 AUTOMATIC ANALYZER

TOPIC # 032 WATER TREATMENT EQUIP CALIB DEHAVEN
CHLORINE CALIBRATION DEHAVEN
49510 CHLORINE CALIBRATION, GENERAL
49511 CHLORINE RESIDUAL TEST
49512 INJECTOR ADJUSTMENT
49513 DOCUMENTATION
CHEMICAL FEEDERS DEHAVEN
49520 CHEMICAL FEEDERS, GENERAL
49521 DETERMINATION OF FEED RATE
49522 INSTRUMENT ADJUSTMENT
49523 DOCUMENTATION
AGITATORS DEHAVEN
49530 AGITATORS, GENERAL
49531 DETERMINATION OF SPEED
49532 ADJUSTMENT
49533 DOCUMENTATION
PUMPS DEHAVEN
49540 PUMPS, GENERAL
49541 DETERMINATION OF DISCHARGE
49542 ADJUSTMENT OF PUMP RATE
49543 DOCUMENTATION
CLARIFIER DEHAVEN
49550 CLARIFIER, GENERAL
49551 DETERMINATION OF SPEED
49552 ADJUSTMENT OF RATE
49553 DOCUMENTATION
FILTERS DEHAVEN
49560 FILTERS, GENERAL
49561 DETERMINATION OF FILTRATION RATE
49562 HEAD OR PRESSURE ADJUSTMENTS
49563 DOCUMENTATION
INSTRUMENTATION DEHAVEN
49570 INSTRUMENTATION, GENERAL
49571 DETERMINATION OF MEASURED CONDITION
49572 CALIBRATION
49573 DOCUMENTATION

	TESTING		DEHAVEN
	49580	TESTING, GENERAL	
	49581	SAMPLE COLLECTIONS	
	49582	TREATMENT OF APPLICATION	
	49583	DOCUMENTATION	
	WEIRS		DEHAVEN
	49590	WEIRS, GENERAL	
	49591	CALIBRATION OF FLOWS	
	49592	DOCUMENTATION	
TOPIC # 033	WATER WELL M&R		DEHAVEN
	WATER WELL MAINTENANCE AND REPAIR		DEHAVEN
	45180	WELL REPAIR, GENERAL	
	45181	SURFACE SEALS	
	45182	CASING	
	45183	SCREENS	
	45184	FILTER PACK	
	45185	BAILING	
	45186	SURGING	
	45187	FLUSHING	
	45188	DISINFECTION	
	45189	BLASTING	
TOPIC # 034	WATER WELL INSPECTION		DEHAVEN
	QUALITY		DEHAVEN
	61410	QUALITY, GENERAL	
	61411	SAMPLING	
	CAPACITY		DEHAVEN
	61420	CAPACITY, GENERAL	
	61421	PUMP TESTS	
	61422	TELEVISION LOG	
	61423	RADIOLOGICAL LOG	
	61424	CURRENT METER	
	61425	TEMPERATURE LOG	
	61426	CALIPER LOG	
TOPIC # 035	SEWER LINE M&R		DEHAVEN
	CLEANING		DEHAVEN
	45210	CLEANING, GENERAL	
	45211	ROTARY CUTTER	
	45212	HYDRAULIC SCOURING	
	45213	CHEMICAL	
	45214	RODDING	
	PIPE LINING		DEHAVEN
	45250	PIPE LINING, GENERAL	
	45251	MATERIALS	
	45252	JOINTS	
	45255	TESTING	
	MANHOLES		DEHAVEN
	45260	MANHOLES, GENERAL	
	45263	GROUT	
	45264	FRAME AND COVER	
	SEWER LINE GROUTING		DEHAVEN
	45270	SEWER LINE GROUTING, GENERAL	
	45272	MATERIAL	
TOPIC # 036	SEWER LINE INSPECTION		DEHAVEN

	HYDRAULIC SCOURING		DEHAVEN
	61510	HYDRAULIC SCOURING, GENERAL	
	61511	EXTENT OF CLEANING	
	TELEVISION INSPECTION		DEHAVEN
	61520	TELEVISION INSPECTION, GENERAL	
	61521	EXTENT OF INSPECTION	
	TRACER DYES		DEHAVEN
	61530	TRACER DYES, GENERAL	
	61531	EXTENT OF TRACING	
	61532	MATERIAL	
	SMOKE		DEHAVEN
	61540	SMOKE, GENERAL	
	61541	EXTENT OF TEST	
	VISUAL INSPECTION		DEHAVEN
	61550	VISUAL INSPECTION, GENERAL	
	61551	EXTENT OF INSPECTION	
	MANHOLE INSPECTION		DEHAVEN
	61560	MANHOLE INSPECTION, GENERAL	
	FLOW MEASUREMENT		DEHAVEN
	61570	FLOW MEASUREMENT, GENERAL	
	61571	FLUMES	
	61572	WEIRS	
	61573	FLOAT ACTUATED METERS	
	61575	AIR REACTION	
	WATER BALANCE		DEHAVEN
	61580	WATER BALANCE, GENERAL	
	REPORTS		DEHAVEN
	61590	REPORTS, GENERAL	
TOPIC #-037	GAS LINE INSPECTION		DEHAVEN
	PIPE		DEHAVEN
	66210	PIPE, GENERAL	
	66211	STEEL	
	66212	PVC	
	66213	POLYETHYLENE	
	66270	PRESSURE TEST	
	ACCESSORIES		DEHAVEN
	66220	ACCESSORIES, GENERAL	
	66221	ADAPTERS	
	66222	PRESSURE REGULATORS	
	66223	VALVE BOXES	
	METERS		DEHAVEN
	66230	METERS, GENERAL	
	66231	BYPASS LINE	
	VALVES		DEHAVEN
	66240	VALVES, GENERAL	
	66241	PLUG	
	WELDING		DEHAVEN
	66250	WELDING, GENERAL	
	COATINGS		DEHAVEN
	66260	COATINGS, GENERAL	
	66261	COAL TAR	
	66262	PLASTIC RESIN	
	66263	EPOXY	
TOPIC # 038	SEWAGE TREATMENT PLANT M&R		DEHAVEN

COMMINUTOR AND BAR SCREEN		DEHAVEN
51110	COMMINUTOR & SCREEN, GENERAL	
51111	COMMINUTOR MOTOR	
51112	CUTTER BLADES	
51113	SCREENS	
AERATION TANK		DEHAVEN
51120	AERATION TANK, GENERAL	
51121	CONCRETE TANK	
51122	STEEL TANK	
51123	SAND BLASTING	
AIR DISTRIBUTION SYSTEM		0002000
51130	AIR DISTRIBUTION SYSTEM, GENERAL	
51131	DIFFUSERS	
SLUDGE DIGESTER		DEHAVEN
51140	SLUDGE DIGESTER, GENERAL	
51141	TANK	
SLUDGE DRYING BED		DEHAVEN
51151	WALLS	
51152	UNDER-DRAIN	
51153	SAND	
51154	GRAVEL	
ROTATING BIOLOGICAL FILTER		DEHAVEN
51160	ROTATING BIOLOGICAL FILTER, GENERAL	
51161	FILTER MEDIA	
TRICKLING FILTER		DEHAVEN
51170	TRICKLING FILTER, GENERAL	
51171	FILTER MEDIA	
51172	DISTRIBUTION ARMS	
TERTIARY FILTER		DEHAVEN
51180	TERTIARY SAND FILTER, GENERAL	
51181	FILTER MEDIA	
51182	UNDER-DRAIN COLLECTION SYSTEM	
51183	FILTER HOUSING	
MICRO SCREEN		DEHAVEN
51190	MICRO-SCREEN, GENERAL	
51191	FILTER SCREEN	
CLARIFIER		DEHAVEN
51220	CLARIFIER, GENERAL	
51221	SLUDGE RAKE	
LAGOONS		DEHAVEN
51230	LAGOONS, GENERAL	
51231	OUTLET STRUCTURE	
51232	INLET STRUCTURE	
51233	LINING	
51234	RIP-RAP	
51235	PARTITIONS	
SEPTIC TANKS AND GREASE TRAPS		DEHAVEN
51240	SEPTIC TANKS & GREASE TRAPS, GENERAL	
FLOW MEASUREMENT DEVICES		DEHAVEN
51250	FLOW MEASUREMENT DEVICES, GENERAL	
51251	WEIR	
51252	FLOAT ACTUATED METERS	
51253	ELECTRICAL RESISTANCE METERS	
VACUUM FILTER		0002000
51260	VACUUM FILTER, GENERAL	
51261	FILTER	

	CENTRIFUGE		DEHAVEN
	51270	CENTRIFUGE, GENERAL	
	INCINERATOR		DEHAVEN
	51280	INCINERATOR, GENERAL	
	51281	BURNER	
	GAS INJECTION EQUIPMENT		DEHAVEN
	51290	GAS INJECTION EQUIPMENT, GENERAL	
	51291	INJECTOR	
	51292	FLOW CONTROLLER	
	51293	EVAPORATOR	
	51294	HOUSING	
	INSTRUMENTATION		DEHAVEN
	51310	INSTRUMENTATION, GENERAL	
	51311	PH METER	
	51312	DISSOVED OXYGEN METER	
	51313	CHLORINE ANALYZER	
	51314	THERMOMETER	
	51315	SOLIDS ANALYZER	
	DOSING SYPHONS		DEHAVEN
	51320	DOSING SYPHONS, GENERAL	
	51321	SYPHON TANK	
	51322	SYPHON	
	FLOCCULATORS AND SCRAPERS		DEHAVEN
	51330	FLOCCULATORS & SCRAPERS, GENERAL	
	IMHOFF TANKS		DEHAVEN
	51340	IMHOFF TANK, GENERAL	
	GRIT CHAMBERS		DEHAVEN
	51350	GRIT CHAMBERS, GENERAL	
TOPIC # 039	INTERIOR PLUMBING		DEHAVEN
	INTERIOR PLUMBING		DEHAVEN
	45410	INTERIOR PLUMBING-GENERAL	
	45411	DRINKING WATER DISPENSERS	
	45412	HOT WATER GENERATORS & STORAGE TANKS	
	45413	PNEUMATIC WATER SUPPLY SYSTEMS	
	45414	LAVATORIES	
	45415	WATER CLOSETS	
	45416	SINKS	
	45417	DRAINS	
	45418	SHOWERS	
	45419	HOT WATER HEATERS-GAS FIRED	
	45420	HOT WATER HEATERS-OIL FIRED	
	45421	HOT WATER HEATERS-ELECTRIC	
	45422	URINALS	
	45423	BATHTUBS	
	45424	LAUNDRY TUBS	
TOPIC # 040	PIPING, VALVES AND ACCESSORIES		DEHAVEN
	PIPING		DEHAVEN
	46910	PIPING, GENERAL	
	46911	STEEL	
	46912	COPPER AND BRASS	
	46914	CAST AND DUCTILE IRON	
	46915	POLYVINYL CHLORIDE	
	46916	ACRYLONITRILE - BUTADIENE - STYRENE (ABS)	
	46917	VITRIFIED CLAY	

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                    46918   ASBESTOS CEMENT
                    46919   POLYETHYLENE
                    46920   CLASS A CONDUIT-SYSTEMS
               INSULATION                                        DEHAVEN
                    46930   INSULATION, GENERAL
                    46931   ABOVE GROUND
                    46932   BELOW GROUND
               VALVES                                            DEHAVEN
                    46940   VALVES, GENERAL
                    46941   GATE
                    46942   GLOBE
                    46943   CHECK
                    46944   NEEDLE
                    46945   BALL
                    46946   BUTTERFLY
                    46947   PRESSURE RELIEF
                    46948   PRESSURE REGULATOR
                    46949   FLOW CONTROL
                    46950   BACKFLOW PREVENTER
                    46951   VACUUM BREAKERS
                    46952   SOLENOID OPERATED
                    46953   AIR RELEASE
                    46954   AIR AND VACUUM RELEASE
                    46955   FLOAT
                    46956   STOP AND WASTE
                    46957   CORPORATION COCKS
                    46958   PLUGS AND COCKS
                    46959   DIAPHRAGM
               ACCESSORIES                                       DEHAVEN
                    46960   ACCESSORIES, GENERAL
                    46961   FILTERS AND STRAINERS
                    46962   TRAPS
                    46963   FILTER DRIERS
                    46964   EXPANSION JOINTS
                    46965   SUPPORTS
                    46966   ADAPTERS
                    46967   VALVE BOXES
                    46968   VIBRATION ELIMINATORS (FLEXIBLE)
               INSTALLATION                                      DEHAVEN
                    46970   INSTALLATION,GENERAL
                    46971   EXCAVATION
                    46972   BEDDING
                    46973   BACKFILL
                    46974   CONNECTIONS
                    46975   HYDROSTATIC PRESSURE TESTS
                    46976   PNEUMATIC PRESSURE TESTS

TOPIC # 041    STEAM, WATER, AND CONDENSATE DISTRIBUTION SYSTEMS M&R    DEHAVEN
               STEAM, WATER, AND CONSENSATE DISTRIBUTION SYST DEHAVEN
                    46270   STEAM, WATER, AND CONDENSATE DISTRIBUTION SYSTEMS, GENERAL
                    46271   LOW PRESSURE STEAM
                    46272   HIGH PRESSURE STEAM
                    46273   HOT WATER
                    46274   CHILLED WATER
                    46275   CONDENSATE

TOPIC # 042    REFRIGERATION AND AIR CONDITIONING INSP. & PREV MAINT.    DEHAVEN
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	COILS		DEHAVEN
		66310 COILS, GENERAL	
	COMPRESSOR UNITS		DEHAVEN
		66330 COMPRESSOR UNITS, GENERAL	
		66331 RECIPROCATING	
		66332 CENTRIFUGAL	
		66333 ABSORPTION	
		66334 ROTARY SCREW	
	CONDENSER UNITS		DEHAVEN
		66340 CONDENSER UNITS, GENERAL	
		66341 AIR-COOLED	
		66342 WATER-COOLED	
	LIQUID CHILLERS		DEHAVEN
		66350 LIQUID CHILLERS, GENERAL	
	EVAPORATORS		DEHAVEN
		66360 EVAPORATORS, GENERAL	
	COOLING TOWERS		DEHAVEN
		66370 COOLING TOWERS, GENERAL	
	UNIT AIR CONDITIONERS		DEHAVEN
		66380 UNIT AIR CONDITIONERS, GENERAL	
TOPIC # 043	BOILER PLANT EQUIPMENT CALIBRATION		DEHAVEN
	INSTRUMENTS		DEHAVEN
		46870 INSTRUMENTS, GENERAL	
		46871 PRESSURE GAGES	
		46872 TEMPERATURE GAGES	
		46873 CONTROL VALVES	
		46874 PRESSURE REDUCING VALVES AND DESUPERHEATERS	
		46875 FLOW METERS	
		46876 RECORDERS	
	FLUE STACK ANALYZERS		DEHAVEN
		46880 FLUE STACK ANALYZERS, GENERAL	
		46881 OPACITY	
		46882 CARBON DIOXIDE	
		46883 OXYGEN	
		46884 TEMPERATURE	
	CONTROLLERS		DEHAVEN
		46890 CONTROLLERS, GENERAL	
		46891 PLANT PNEUMATIC	
		46892 PLANT ELECTRIC	
		46893 BOILER COMBUSTION	
		46894 BOILER SAFETY	
TOPIC # 044	COMPRESSED AIR EQUIPMENT REPAIR		DEHAVEN
	COMPRESSORS		DEHAVEN
		46470 COMPRESSORS, GENERAL	
		46471 CENTRIFUGAL	
		46472 RECIPROCATING	
		46473 ROTARY AND SCREW	
		46474 CONTROLS	
	ACCESSORIES		DEHAVEN
		46480 ACCESSORIES, GENERAL	
		46481 AFTERCOOLERS	
		46482 RECEIVERS	
TOPIC # 045	STACKS AND BREECHINGS		DEHAVEN

STACKS — DEHAVEN

46160 STACKS, GENERAL
46161 METAL
46162 MASONRY
46163 PREFABRICATED

BREECHINGS — DEHAVEN

46165 BREECHING, GENERAL
46166 METAL
46167 MASONRY
46168 REFRACTORY BRICK

TOPIC # 046 FUEL STORAGE AND HANDLING SYSTEMS M&P — DEHAVEN

FUEL STORAGE AND HANDLING SYSTEMS — DEHAVEN

46100 FUEL STORAGE AND HANDLING SYSTEMS, GENERAL
46110 OIL STORAGE AND DISTRIBUTION SYSTEMS
46120 GAS STORAGE AND DISTRIBUTION SYSTEMS
46130 COAL STORAGE AND DISTRIBUTION SYSTEMS
46140 STOKERS AND CONVEYORS
46150 ASH REMOVAL EQUIPMENT

DRAFT CONTROL EQUIPMENT — DEHAVEN

46170 DRAFT CONTROL EQUIPMENT

TOPIC # 047 FIRE PROTECTION SPRINKLER SYSTEMS — DEHAVEN

FIRE PROTECTION SYSTEMS — DEHAVEN

66410 FIRE PROTECTION SYSTEMS, GENERAL
66411 AQUAREOUS FILM FORMING SYSTEM
66412 SPRINKLER HEADS
66413 FIRE DEPARTMENT CONNECTIONS
66414 VALVES
66415 HIGH EXPANSION FOAM SYSTEM
66416 DETECTOR OPERATED SPRINKLER SYSTEM
66417 DELAYED ACTION SPRINKLER SYSTEM
66418 CO2 SYSTEMS
66419 HALON SYSTEMS
66420 STANDPIPES
66421 HOSE STATIONS
66422 EXTINGUISHER CABINETS
66423 DRY CHEMICAL SYSTEM

ALARM AND DETECTION — DEHAVEN

66510 ALARM AND DETECTION, GENERAL
66511 HEAT DETECTORS
66512 FIRE ALARM TRANSMITTERS AND RECEIVERS
66513 SINGLE STATION SMOKE DETECTORS (SELF-CONTAINED)
66514 DUCT SMOKE DETECTORS
66515 INTERLOCKS

TOPIC # 048 SECURITY PROTECTION DEVICES — DEHAVEN

INSPECTION AND TESTING — DEHAVEN

66600 SECURITY PROTECTION DEVICES, INSPECTION & TESTING, GENERAL
66610 CONTROL UNIT
66620 MONITOR & DISPLAY EQUIPMENT
66630 DATA TRANSMISSION SYSTEM
66640 AUDIBLE ALARM
66650 BALANCED MAGNETIC SWITCH
66660 CAPACITANCE PROXIMITY SENSOR
66670 GRIDWIRE SENSOR

66680 VIBRATION SENSOR
66690 PASSIVE ULTRASONIC SENSOR
66710 ULTRASONIC MOTION SENSOR
66720 MAGNETIC WEAPON SENSOR
66730 DURESS SENSOR

TOPIC # 049 INTERIOR ELECTRICAL MAR DEHAVEN

DISCONNECT DEVICES DEHAVEN
48110 DISCONNECT DEVICES, GENERAL
48111 FUSED SAFETY SWITCHES
48112 UNFUSED SAFETY SWITCHES
48113 NON-AUTOMATIC CIRCUIT BREAKERS
48114 THERMAL-MAGNETIC CIRCUIT BREAKERS
48115 MAGNETIC CIRCUIT BREAKERS (MOTOR CIRCUIT BREAKERS)
48116 GROUND FAULT CURRENT INTERRUPTERS
48117 FUSES
48118 ENCLOSURES
48119 OUTAGES, TESTING, REMOVAL AND REPLACEMENT

PANELBOARDS AND LOAD CENTERS DEHAVEN
48130 PANELBOARDS AND LOAD CENTERS, GENERAL
48131 CIRCUIT BREAKERS
48132 FUSED SWITCH
48133 ENCLOSURES
48134 OUTAGES AND TESTING

POWER SYSTEMS DEHAVEN
48210 POWER SYSTEMS, GENERAL
48211 UNIT SUBSTATIONS
48212 LOW VOLTAGE SWITCHGEAR
48213 HIGH VOLTAGE SWITCHGEAR
48214 SWITCHBOARDS
48215 MOTOR CONTROL CENTERS (LOW VOLTAGE AND HIGH VOLTAGE)

EMERGENCY POWER AND CONVERSION DEHAVEN
48220 EMERGENCY POWER AND CONVERSION, GENERAL
48221 ENGINE GENERATORS
48222 STEAM TURBINE GENERATORS
48223 MOTOR GENERATORS
48224 DIRECT CURRENT
48225 UNINTERRUPTIBLE POWER SYSTEMS
48226 AUTOMATIC AND MANUAL TRANSFER SWITCHES

TRANSFORMERS DEHAVEN
48300 TRANSFORMERS, GENERAL
48310 AUTOMATIC, DRY TYPE-GENERAL PURPOSE
48320 INSTRUMENT TRANSFORMERS, DRY-TYPE-GENERAL PURPOSE
48330 CONTROL TRANSFORMERS, DRY TYPE-GENERAL PURPOSE
48340 GROUNDING TRANSFORMERS, DRY TYPE-GENERAL PURPOSE
48350 LIQUID-FILLED-MINERAL OIL AND NON-BURNING, SELF-PROTECTED,
48360 OUTAGES AND TESTING, DRY TYPE-GENERAL PURPOSE

WIRING METHODS DEHAVEN
48400 WIRING METHODS, GENERAL
48410 CONDUCTORS
48411 COPPER
48412 ALUMINUM
48413 INSULATION
48414 BUS DUCTS
48420 RACEWAYS
48421 RIGID GALVANIZED STEEL

48422 ALUMINUM
48423 ELECTRICAL METALLIC TUBING
48424 FLEXIBLE

BOXES DEHAVEN
48430 BOXES, GENERAL
48431 JUNCTION AND OUTLET
48432 PULL

WIRING DEVICES DEHAVEN
48440 WIRING DEVICES, GENERAL
48441 SWITCHES
48442 RECEPTACLES
48443 PLUGS AND CONNECTORS

LIGHTING FIXTURES DEHAVEN
48500 LIGHTING FIXTURES, GENERAL
48510 INCANDESCENT
48520 FLUORESCENT
48530 METAL-HALIDE
48540 MERCURY VAPOR
48550 SODIUM VAPOR
48560 BALLASTS
48570 OUTAGES AND TESTING

ELECTRIC MOTORS DEHAVEN
48600 ELECTRIC MOTORS, GENERAL
48610 INDUCTION, SINGLE-PHASE
48612 UNIVERSAL, SINGLE-PHASE
48620 SQUIRREL-CAGE, POLYPHASE
48621 WOUND ROTOR, POLYPHASE
48622 SYNCHRONOUS, POLYPHASE
48630 DIRECT CURRENT
48640 MOTOR CONTROLS
48650 OUTAGES AND TESTING

ELECTRIC HEATING AND COOKING EQUIPMENT DEHAVEN
48700 ELECTRIC HEATING & COOKING EQUIPMENT, GENERAL
48710 CONVECTION
48720 FORCED CONVECTION (UNIT AND CABINET-TYPE)
48730 HEATING CABLE
48740 CONTROLS
48750 RANGES AND OVENS
48760 OUTAGES AND TESTING

SIGNAL SYSTEMS DEHAVEN
48810 SIGNAL SYSTEMS, GENERAL
48811 INTERCOM
48812 FIRE ALARM
48813 OUTAGES AND TESTING

CENTRAL MONITORING AND CONTROL DEHAVEN
48820 CENTRAL MONITORING & CONTROL, GENERAL
48821 INSTRUMENTATION
48822 ANNUNCIATORS
48823 CONTROL SWITCHBOARDS
48824 TIMING DEVICES
48825 LIMIT SWITCHES
48826 ALTERNATORS
48827 OUTAGES AND TESTING

ELECTRICAL EQUIPMENT AND WIRING IN HAZARDOUS A DEHAVEN
48910 ELECTRICAL EQUIP. & WIRING IN HAZARDOUS AREAS, GENERAL
48920 ENCLOSURES

48930 CONDUIT AND CONDUIT FITTINGS
48940 TESTING

TOPIC # 050 PUMPS DEHAVEN

PUMPS DEHAVEN
48660 PUMPS, GENERAL
48661 CENTRIFUGAL
48662 TURBINE
48663 SCREW
48664 RECIPROCATING
48665 ROTARY
48666 DIAPHRAGM
48667 SUMP
48668 SUBMERSIBLE
48669 SEWAGE
48670 GEAR

TOPIC # 051 ELEC DIST SYSTEM M&R DEHAVEN

SUBSTATIONS DEHAVEN
47210 SUBSTATIONS, GENERAL
47211 POWER TRANSFORMERS
47212 STATION SERVICE TRANSFORMERS
47213 AUTOMATIC TAP CHANGING TRANSFORMERS
47214 SWITCHGEAR
47215 OIL CIRCUIT BREAKERS
47216 ISOLATING SWITCHES
47217 METERING SUBSTATIONS
47218 RELAYING SUBSTATIONS
47219 STATION BATTERY SYSTEM
47220 ARTICULATED SECONDARY UNIT SUBSTATION
47221 INTEGRAL TRANSFORMER-LOAD CENTERS
47222 OUTAGES AND TESTING

TRANSFORMERS, DISTRIBUTION DEHAVEN
47230 TRANSFORMERS, DISTRIBUTION, GENERAL
47231 POLE MOUNTED
47232 PAD MOUNTED
47233 OUTAGES AND TESTING

CAPACITOR BANKS DEHAVEN
47270 CAPACITOR BANKS, GENERAL

REGULATORS DEHAVEN
47280 REGULATORS, GENERAL

OVERHEAD DISTRIBUTION DEHAVEN
47300 OVERHEAD DISTRIBUTION, GENERAL
47311 WOOD POLES
47312 METAL POLES
47313 CONCRETE POLES
47320 CROSSARMS AND BRACES
47330 SECONDARY RACKS
47341 BARE COPPER CONDUCTORS
47342 BARE ALUMINUM CONDUCTORS
47343 ALUMINUM CABLE STEEL REINFORCED
47344 SPLICES AND CONNECTORS
47361 PIN INSULATORS
47362 LINE POST INSULATORS
47363 SUSPENSION INSULATORS
47364 SPOOL INSULATORS

	47365	GUY-STRAIN AND PIN INSULATORS	
	47370	GUY-STRENGTHS AND MATERIALS	
	47381	LOG ANCHORS	
	47382	SWAMP ANCHORS	
	47383	ROCK ANCHORS	
	47390	POLE-LINE HARDWARE	
	47395	CLEARING RIGHT-OF-WAY	
	47399	OUTAGES AND TESTING	
UNDERGROUND DISTRIBUTION			DEHAVEN
	47400	UNDERGROUND DISTRIBUTION, GENERAL	
	47410	HANDHOLES AND MANHOLES	
	47421	PRIMARY CABLES	
	47422	SECONDARY CABLES	
	47423	DIRECT BURIAL CABLE	
	47431	ASBESTOS-CEMENT DUCTS	
	47432	FIBER DUCTS	
	47433	CLAY DUCTS	
	47434	CONCRETE DUCTS	
	47435	PLASTIC DUCTS	
	47436	STEEL DUCTS	
	47440	CABLE TERMINATIONS AND SPLICES	
	47450	HARDWARE	
	47451	MARKERS FOR UNDERGROUND LINES	
	47460	OUTAGES AND TESTING	
DISCONNECTS			DEHAVEN
	47600	GENERAL	
	47610	FUSED CUTOUTS	
	47620	AIR BREAK SWITCHES	
	47621	HOOK OPERATED SWITCHES	
	47622	GANG OPERATED SWITCHES	
	47630	SECTIONALIZING SWITCHES	
	47640	AUTOMATIC CIRCUIT RECLOSERS	
	47650	FUSES	
	47660	OIL-FILLED SWITCHES	
	47670	OUTAGES AND TESTING	
LIGHTNING ARRESTERS			DEHAVEN
	47710	LIGHTNING ARRESTERS, GENERAL	
	47711	EXPULSION TYPE	
	47712	VALVE TYPE	
GROUNDING			DEHAVEN
	47720	GROUNDING, GENERAL	
	47721	MATERIALS	
	47722	TESTING	

TOPIC # 052 — ELECTRICAL DISTRIBUTION SYSTEM INSPECTION — DEHAVEN

SYSTEM COORDINATION			DEHAVEN
	67300	SYSTEM COORDINATION, GENERAL	
	67310	FUSING	
	67320	FEEDER BREAKER SETTINGS	
	67330	RELAY SETTINGS	
RELAY CALIBRATION			DEHAVEN
	67340	RELAY CALIBRATION, GENERAL	
	67350	OVERCURRENT RELAYS	
	67360	IMPEDANCE RELAYS	
	67370	TEST EQUIPMENT	
METERING			DEHAVEN

	67380	METERING, GENERAL	
	67390	CALIBRATION	
GROUNDING			DEHAVEN
	67400	GROUNDING, GENERAL	
	67410	RESISTANCE MEASUREMENT	
	67420	SUBSTATION GROUNDING	
	67430	POLE GROUNDING	
	67440	LIGHTNING ARRESTERS	
OIL TESTING			DEHAVEN
	67450	OIL TESTING, GENERAL	
	67460	TRANSFORMERS	
	67470	SWITCHES	
	67480	RECLOSURES AND SECTIONALIZERS	
CONTROLS			DEHAVEN
	67610	CONTROLS, GENERAL	
	67620	CONTROL CABLES	
	67630	TIMING DEVICES	
OVERHEAD LINE CONDITIONS			DEHAVEN
	67640	OVERHEAD LINE CONDITIONS, GENERAL	
	67650	HEAT SENSING FOR DEFECTIVE CONNECTIONS AND TERMINALS	
	67660	INSULATOR LEAKAGE	
	67670	CORONA	
CABLE TESTING			DEHAVEN
	67710	CABLE TESTING, GENERAL	
	67720	MEGGER TESTS	
	67730	D.C. PROOF TESTS	

TOPIC # 053 STREET AND AREA LIGHTING SYSTEM MAR DEHAVEN

POLES			DEHAVEN
	47510	POLES, GENERAL	
	47511	WOOD	
	47512	METAL	
	47513	CONCRETE	
BRACKETS			DEHAVEN
	47520	BRACKETS, GENERAL	
LUMINAIRES			DEHAVEN
	47530	LUMINAIRES, GENERAL	
	47531	ENCLOSED	
	47532	OPEN	
	47533	INCANDESCENT	
	47534	FLUORESCENT	
	47535	MERCURY VAPOR	
	47536	H.P. SODIUM	
	47537	BALLAST	
	47538	ISOLATING TRANSFORMERS	
	47539	OUTAGES & TESTING	
FLOODLIGHTS			DEHAVEN
	47540	FLOODLIGHTS, GENERAL	
	47541	INCANDESCENT	
	47542	BALLAST	
	47543	OUTAGES & TESTING	
TRANSFORMERS			DEHAVEN
	47550	TRANSFORMERS, GENERAL	
	47551	OUTAGES & TESTING	
CONTROLS			DEHAVEN
	47560	CONTROLS, GENERAL	

```
                    47561   PHOTOCELLS & TIMERS
                    47562   CONTACTORS
                    47563   OUTAGES & TESTING

TOPIC # 054     PEST CONTROL SERVICE                                    DEHAVEN
                PEST CONTROL CHEMICALS                                  DEHAVEN
                    70510   PEST CONTROL CHEMICALS, GENERAL
                    70511   INSECTICIDES
                    70512   RODENTICIDES
                    70513   FUMIGANTS
                    70514   REPELLANTS
                INSECTICIDE DISPERSAL EQUIPMENT AND UTILIZATIO DEHAVEN
                    70520   INSECTICIDE DISPERSAL EQUIPMENT AND UTILIZATION, GENERAL
                    70521   GROUND DISPERSAL
                    70522   AERIAL DISPERSAL
                INSECTS AND OTHER ARTHROPODS                            DEHAVEN
                    70530   INSECTS AND OTHER ARTHROPODS, GENERAL
                    70531   MOSQUITOS
                    70532   FLIES
                    70533   BEDBUGS
                    70534   LICE,FLEAS,MITES AND TICKS
                    70535   ANTS
                    70536   COCKROACHES
                    70537   STORED PRODUCTS PESTS
                    70538   INSECTS DAMAGING TURF, SHRUBS, TREES AND FORESTS
                    70539   VENOMOUS ARTHROPODS
                STRUCTURAL PESTS                                        DEHAVEN
                    70540   STRUCTURAL PESTS, GENERAL
                    70541   TERMITES
                    70542   OTHER WOOD-DESTROYING INSECTS
                    70543   WOOD-DESTROYING FUNGI
                    70544   MARINE BORERS
                RODENTS AND OTHER VERTEBRATES                           DEHAVEN
                    70550   RODENTS AND OTHER VERTEBRATES, GENERAL
                    70551   COMMENSAL (DOMESTIC) RODENTS
                    70552   FERAL (FIELD) RODENTS AND OTHER MAMMALIAN PESTS
                NON-ARTHROPOD INVERTEBRATES                             DEHAVEN
                    70560   NON-ARTHROPOD INVERTEBRATES, GENERAL
                    70561   NEMATODES
                    70562   SNAILS AND SLUGS

TOPIC # 055     CUSTODIAL SERVICE                                       DEHAVEN
                CUSTODIAL SERVICES                                      DEHAVEN
                    70100   CUSTODIAL SERVICES, GENERAL

TOPIC # 056     WINDOW CLEANING SERVICE                                 DEHAVEN
                WINDOW CLEANING SERVICE                                 DEHAVEN
                    70210   WINDOW CLEANING SERVICE, GENERAL

TOPIC # 057     GROUNDS MAINTENANCE SERVICES                            DEHAVEN
                SOIL SURVEYS                                            DEHAVEN
                    70310   SOIL SURVEYS, GENERAL
                    70311   SOIL FERTILITY AND FERTILIZERS
                    70312   SOIL TEXTURE AND CLASSIFICATION
                GRASSES,LEGUMES AND GROUND COVERS                       DEHAVEN
                    70320   GRASSES, LEGUMES AND GROUND COVERS, GENERAL
```

70321 MATERIALS
70322 PLANTING OPERATIONS
70323 MAINTAINING PLANTINGS
TREES, SHRUBS AND VINES DEHAVEN
70330 TREES, SHRUBS AND VINES, GENERAL
70331 MATERIALS
70332 PLANTING OPERATIONS
70333 MAINTAINING PLANTINGS
OUTLEASES DEHAVEN
70340 OUTLEASES, GENERAL
70341 GRAZING
70342 CROPS AND HAY
CONTROL MEASURES DEHAVEN
70350 CONTROL MEASURES, GENERAL
70351 DRAINAGE
70352 EROSION
70353 WEED AND BRUSH CONTROL
70354 FIRE PREVENTION AND PROTECTION
70355 PREVENTIVE MAINTENANCE
RECREATIONAL AREA MAINTENANCE DEHAVEN
70360 RECREATIONAL AREA MAINTENANCE, GENERAL

TOPIC # 058 REFUSE COLLECTION SERVICES DEHAVEN
REFUSE CONTAINERS DEHAVEN
70410 REFUSE CONTAINERS, GENERAL
70411 HOUSEHOLD REFUSE CONTAINERS
70412 HOUSEHOLD TREATMENT
70413 INDUSTRIAL REFUSE CONTAINERS
70414 CONTAINER CLEANING
70415 CONTAINER MAINTENANCE
REFUSE COLLECTION DEHAVEN
70420 REFUSE COLLECTION, GENERAL
70421 QUANTITIES
70422 REFUSE COLLECTION ROUTES
70423 REFUSE COLLECTION FREQUENCY
70424 REFUSE COLLECTION VEHICLES
70425 REFUSE DISPOSAL

TOPIC # 059 REFUSE DISPOSAL SERVICES DEHAVEN
REFUSE CLASSIFICATION DEHAVEN
70450 REFUSE CLASSIFICATION, GENERAL
70451 HOUSEHOLD REFUSE CLASSIFICATION
70452 INDUSTRIAL REFUSE CLASSIFICATION
70453 TRASH CLASSIFICATION
REFUSE DISPOSAL DEHAVEN
70460 REFUSE DISPOSAL, GENERAL
70461 QUANTITIES
70462 LANDFILL
70463 INCINERATION
70464 OCEAN DUMPING
70465 SCRAP SALES

TOPIC # 060 WILDLIFE MANAGEMENT DEHAVEN
WILDLIFE HABITAT DEHAVEN
71310 WILDLIFE HABITAT, GENERAL
71311 BIG GAME HABITAT

```
                    71312   SMALL GAME HABITAT
                    71313   NON-GAME HABITAT
                    71314   ENDANGERED SPECIES
                    71315   INDIGENOUS SPECIES
                    71316   HABITAT IMPROVEMENT
               WILDLIFE CONTROL                                    DEHAVEN
                    71320   WILDLIFE CONTROL, GENERAL
                    71321   GAME SPECIES CONTROL
                    71322   NON-GAME SPECIES CONTROL
               WILDLIFE RESTORATION                                0002000
                    71330   WILDLIFE RESTORATION, GENERAL
                    71331   RESTOCKING SPECIES
               WILDLIFE PROTECTION                                 DEHAVEN
                    71340   WILDLIFE PROTECTION, GENERAL

TOPIC # 061    FOREST MANAGEMENT SERVICES                                    DEHAVEN
               FOREST MANAGEMENT PLAN                              DEHAVEN
                    71410   FOREST MANAGEMENT PLAN, GENERAL
               BASIC CONCEPTS                                      DEHAVEN
                    71420   BASIC CONCEPTS, GENERAL
                    71421   FOREST RESERVES
                    71422   FOREST INVENTORIES
               TIMBER DISPOSAL                                     DEHAVEN
                    71430   TIMBER DISPOSAL, GENERAL
                    71431   PROCEDURES
                    71432   AVAILABILITY
                    71433   HARVESTING
                    71434   RECORDS
                    71435   MOBILIZATION RESERVES
               FIRE PROTECTION                                     DEHAVEN
                    71440   FIRE PROTECTION, GENERAL
                    71441   FIRE PREVENTION
                    71442   FIRE PROTECTION
               TIMBER ACCESS ROADS                                 DEHAVEN
                    71450   TIMBER ACCESS ROADS, GENERAL
               PROTECTION VS INSECTS,DISEASE & OTHER ENEMIES       DEHAVEN
                    71460   PROTECTION AGAINST ENEMIES, GENERAL
                    71461   DISEASE
                    71462   INSECTS
                    71463   LIVESTOCK
                    71464   DESTRUCTIVE ANIMALS
                    71465   TRESPASS
               FORESTRY                                            DEHAVEN
                    71470   FORESTRY, GENERAL
                    71471   INTERMEDIATE CUTTING
                    71472   HARVEST CUTTING
                    71473   TIMBER STAND IMPROVEMENT
                    71474   REPRODUCTION
                    71475   PLANTING METHODS
                    71476   TREE CLASSIFICATION

TOPIC # 062    AIR POLLUTION MONITORING                                      DEHAVEN
               STATIONARY SOURCE MONITORING                        0002000
                    71110   STATIONARY SOURCE MONITORING, GENERAL
               MOBILE SOURCE MONITORING                            0002000
                    71120   MOBILE SOURCE MONITORING, GENERAL
```

AMBIENT AIR MONITORING DEHAVEN
71130 AMBIENT AIR MONITORING, GENERAL

TOPIC # 063 WATER POLLUTION MONITORING DEHAVEN
SAMPLING DEHAVEN
71210 SAMPLING, GENERAL
71211 MANUAL SAMPLING
71212 AUTOMATIC SAMPLING
71213 BACTERIOLOGICAL SAMPLING
71214 PHYSICAL/CHEMICAL SAMPLING
71215 SAMPLING PRESERVATION
71216 SAMPLING EQUIPMENT
71217 REPORTS
FLOW MEASUREMENT DEHAVEN
71220 FLOW MEASUREMENT, GENERAL
71221 FLOW MEASUREMENT METHODS
71222 FLOW MEASUREMENT EQUIPMENT AND DEVICES
71223 REPORTS
ANALYTICAL CONSIDERATIONS DEHAVEN
71230 ANALYTICAL CONSIDERATIONS, GENERAL
71231 PHYSICAL ANALYSIS
71232 CHEMICAL ANALYSIS
71233 BIOCHEMICAL ANALYSIS
71234 BACTERIOLOGICAL ANALYSIS
71235 REPORTS

TOPIC # 064 CLEANING OF BOILERS AND HEAT EXCHANGERS DEHAVEN
BOILERS DEHAVEN
70810 BOILERS, GENERAL
70811 CHEMICAL CLEANING
70812 MECHANICAL CLEANING
HEAT EXCHANGERS DEHAVEN
70820 HEAT EXHANGERS, GENERAL
70821 CHEMICAL CLEANING
70822 MECHANICAL CLEANING

TOPIC # 065 STEAM AND HOT WATER PLANT M&R DEHAVEN
FIRE TUBE BOILERS DEHAVEN
46210 FIRE TUBE BOILERS
WATER TUBE BOILERS DEHAVEN
46220 WATER TUBE BOILERS
HIGH TEMPERATURE WATER BOILERS DEHAVEN
46230 HIGH TEMPERATURE WATER BOILERS
CAST IRON BOILERS AND FIREBOXES DEHAVEN
46241 CAST IRON BOILERS AND FIREBOXES
FIREBRICK FIREBOXES DEHAVEN
46242 FIREBRICK FIREBOXES FOR BOILERS
BOILER FIREBOXES INSULATED WITH FIREBRICK DEHAVEN
46243 BOILER FIREBOXES INSULATED WITH FIREBRICK
BOILER FIREBOX INSULATION DEHAVEN
46250 BOILER FIREBOX INSULATION
OIL-FIRED BURNERS DEHAVEN
46261 OIL-FIRED BURNERS FOR BOILERS
GAS FIRED BURNERS DEHAVEN
46262 GAS-FIRED BURNERS FOR BOILERS
COAL-FIRED BURNERS DEHAVEN

46263 COAL-FIRED BURNERS FOR BOILERS

BOILER FEEDWATER EQUIPMENT DEHAVEN

46280 BOILER FEEDWATER EQUIPMENT, GENERAL
46281 BOILER FEED PUMPS
46282 DEAERATORS
46283 RECIEVERS AND HOTWELLS
46284 FEEDWATER TREATMENT EQUIPMENT

PACKAGED CONDENSATE RETURN UNITS DEHAVEN

46290 PACKAGED CONSENSATE RETURN UNITS, GENERAL
46291 LOW PRESSURE, SINGLE
46292 LOW PRESSURE, DUPLEX
46293 HIGH PRESSURE, SINGLE
46294 HIGH PRESSURE, DUPLEX

APPENDIX C

SAMPLE RPMA
GUIDE SPECIFICATION

REAL PROPERTY MAINTENANCE ACTIVITIES GUIDE SPECIFICATIONS

RPMA TOPIC 14

DOORS AND WINDOWS

Folding Doors M & R

January 1977

SECTION 38340

FOLDING DOORS

Table of Contents

FOREWORD

This handbook is designed to assist the inspector in determining the condition of facility components, assist the cost estimator in developing the Government estimate for the proposed project, the specification writer in developing and producing adequate specifications, and the procurement specialist in preparing and managing contract documents.

Part I is a checklist designed to assist the inspector in describing the condition of a facility component and provide a format for estimating quantity of work and cost. The checklist includes a set of definitions of technical and trade terms.

Part II discusses contracting methods and recommends appropriate Unit Price Schedule items.

Part III contains the guide specification written in a format to provide the specification writer with guidance for completing the guide specification and space for inserting notes to the contractors. It is recommended that Part III specifications be utilized in the following manner.

Specification writers should review completed checklists and project drawings, if any, and select appropriate sections in Part III for use in preparing the contract.

Specification writers should review the material contained in the first two columns and assure that appropriate action is taken on all decision points. Necessary changes to the center column and any additions are to be note in the third column. Upon completion, the marked-up specifications are ready for processing Part IV specifications.

Part IV contains a two-column format of the guide specifications with the Notes column deleted. All entries in the third column of the Part III specifications are to be transcribed onto the second column of copies of the same sections in Part IV for use as reproducible masters.

Use the "comments" column of the INDEX to indicate "not used" for any specifications not included in the particular contract. Contract specifications can then be reproduced from the modified Part IV specifications.

This handbook will be revised periodically to maintain the specifications and to incorporate additional sections to meet additional requirements.

This handbook is designed for local reproduction.

PART I

CHECKLIST NOTES

1. Form is self-explanatory except for the points discussed below.

2. The "inspector" refers to the individual making the deficiency inspection and not the construction inspection.

3. One line of the table should be used for each deficiency; several lines could be used for each room or space.

4. Cost estimate should be coordinated with the estimates developed on other related checklists such as, Finish Hardware, Door Operators, Weatherstripping and Seals and Thresholds, to avoid duplications.

5. Blank vertical columns under "DEFICIENCY IDENTIFICATION" are for additional deficiencies not listed.

DEFINITIONS

Folding Door - horizontal acting, accordian or pantograph type folding mechanism, usually with top track mounting.

Action: Single fold - fold action one way, to one side right or left.
Biparting - door sections fold action two way, from center to each side.
Pocket - door fold action terminates at open position in an enclosure or pocket.

DEFICIENCY CHECK LIST

Building No. ____________ FOLDING (ACCORDION) DOORS - SECTION 38340 Project No. ____________

Door Material: ☐ Vinyl Fabric ☐ Wood ☐ Fabric/plastic ☐ Other ____________

Drawings Used With Specifications: ☐ Yes ☐ No

Inspector: ______________________ Date __________

Estimator: ______________________ Date __________

SPACE IDENTIFICATION Room No., Area, Passageway	DEFICIENCY IDENTIFICATION																												COST ESTIMATE										
			DOOR									TRACK							OPERATING HARDWARE						OTHER				MATERIALS							LABOR			TOTAL
	INSPECTED	NO DEFICIENCIES	Inoperable	Faulty Operation	Damaged Folding Mechanism	Finish Damaged or Deteriorated	Damaged Lead or Jamb Post	Faulty Carriers	Damaged Seals/Sweeps			Damaged (Door Will Not Operate)	Damaged (Faulty Door Operation)	Loosed From Structure	Brackets Missing/Broken*	Warped, Bent, Etc.			Damaged: Item	Damaged: Item	Missing: Item	Missing: Item			Repair to Adjacent Work	Finish Hardware Broken *	Damaged Frame		Width Height Thickness Opening Size	Repairs to Adjacent Work	Frame	Quantity	Unit	Unit Price	Overhead and Profit	Manhours	Rate	Overhead and Profit	

PART II

Folding doors are normally priced as a unit complete and ready for installation in an existing opening. Folding doors and parts may be purchased then installed by the carpentry trade or the repair of door and parts may be contracted to a firm regularly in the door repair business. For contracting purposes the following unit prices are intended to include the materials and the labor of installation as might be expected from a door repair contractor.

All items for the Unit Price Schedule for a project specification should be listed by each door situation. Measurement should be by the unit listed. Payment should be on the basis of the quantity and the unit price.

Unit Price Schedule

Items for the Unit Price Schedule for a project specification shall be as follows:

Payment for each item includes all material and labor, removal of item, repair, reinstallation, restoration of adjacent or other damaged property to the original condition, adjustments and item cleanup.

Definition of Units: EA. - each, S.F. - square feet, L.F. - lineal feet, L.S. - lump sum.

Item Description	Quantity	Unit
a. Replace the entire door unit, and all door hardware. List by door panel type, opening size, material and type of operation.	_____	L.S.
b. Replace damaged door panel only to function with existing door equipment. This item includes, new curtain finished to match existing. List by door type, material, and panel size.	_____	S.F.
c. Replace door covering only, to function with existing equipment. This item includes, removal of covering, and reinstallation. List by door size and material.	_____	S.F.

Item Description	Quantity	Unit
d. Repair/replacement of individual items, including disconnection, repair/replacement and adjustment. List by each item:		
track	_____	L.F.
track trim	_____	L.F.
door carriers	_____	EA.
panel hinge/folding unit	_____	EA.
door lead rail	_____	EA.
door jamb rail	_____	EA.
door sweeps	_____	EA.
door seals	_____	EA.
door frame	_____	EA.
latch device	_____	EA.
other _____ (identify)	_____	EA.

Bid item for related work which may be bid with the door but is covered by other bid schedules is: motorized door operators.

Items such as finish painting, finish hardware and electrical shall be coordinated with other Unit Price Schedules.

PART III

SECTION 38340

FOLDING DOORS

Notes

This section is intended for use with folding doors of wood and vinyl fabric.

Check issue dates of standard specifications and substitute latest issue if different on this and following pages.

Delete inapplicable references.

Revisions

1.0 SCOPE: This specification covers the requirements for replacement or repair of folding (accordion) doors.

2.0 APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

2.1 Federal Specifications (Fed. Spec):

CCC-W-408A & AM #1	Wall Covering, Vinyl Coated.
TT-C-490B	Cleaning Methods and Pretreatment of Ferrous Surfaces for Organic Coatings.

Notes

Revisions

2.2 American Society for Testing and Materials (ASTM):

A164-71	Electrodeposited Coatings of Zinc on Steel.
A165-71	Electrodeposited Coatings of Cadmium on Steel.
A525-75	Sheet Steel, Zinc Coated (Galvanized) by the Hot Dip Process, General Requirements.
B211-73	Aluminum Alloy Bars, Rod, and Wires.
E84-75	Surface Burning Characteristics of Building Materials.
E90-75	Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

3.0 SUBMITTALS:

3.1 Shop drawings shall be submitted for doors and accessories not fully detailed in manufacturer's literature. Approval shall be obtained before fabrication or delivery of material. Drawings shall show types, sizes, locations, metal gages, hardware provisions, and installation details and procedures. Include field measurements and clearances.

Insert other specific items required for project. Add "fabric sample" if required.

Notes		Revisions
	3.2 Manufacturer's literature shall be submitted which includes installation and operating instructions, and maintenance recommendations.	
	3.3 Certificates shall be submitted certifying that new doors and accessories meet the referenced standards.	
Delete if not required.	3.4 Sound Transmission Certification: A certificate from an independent testing laboratory shall be submitted as evidence that door unit has been tested in accordance with ASTM E90 to achieve the specified Sound Transmission Classification (STC).	
Delete when not required for partial component repair.	3.5 Flame Spread Rating Certificate: A certificate from an independent testing laboratory shall be submitted as evidence that the door unit has been tested and complies with ASTM E84 for the rating specified.	
	4.0 DELIVERY AND STORAGE:	
	4.1 Doors and accessories shall be delivered wrapped in protective coverings, new items in unopened original packages with labels intact, and identifications clearly marked. Damaged items shall be replaced at no additional cost to the Government.	

Notes

Revisions

4.2 All items shall be stored in a manner that will prevent deterioration or damage. All items for each door location shall be stored together.

4.3 Doors shall be handled carefully to prevent damage to faces, edges and ends. Accessories and parts shall be handled to prevent damage to mating surfaces and to fastening points.

5.0 MATERIALS:

138

Confirm local requirements for matching existing manufacturers. Component repairs or replacement shall match existing. Delete last sentence where only partial repair is required.

5.1 The manufacturer shall be a recognized producer of the type of door and accessories specified. Each new door unit shall be a complete unit produced by one manufacturer including hardware, accessories, mounting, and installation components.

Confirm local codes. Add local requirements as required.

5.2 Local approvals required for the performance of this work shall be obtained prior to fabrication of assemblies or installation of materials. All work performed shall meet the requirements of local codes and regulations.

Notes		Revisions
Substitute wood panels or fabric/plastic laminate coated rigid panels, as required to match existing.	5.3 Door shall be full pantograph or "x-accordion" type with flexible fabric panels.	
Delete if rating is not required.	Materials shall have a flame spread rating of 25 or less, fuel contributed of 10 or less, and a smoke developed rating of 5 or less, in compliance with ASTM E84.	
Substitute aluminum for ferrous metal if required to match existing. For aluminum delete "galvanized or cadmium plated" and "phosphate treatment". Aluminum shall comply with ASTM B211	5.4 Framework for door including posts, pantographs, hinges and hinge plates, and support rods shall be ferrous metal. All enclosed metal shall be galvanized ASTM A-164, or cadmium plated ASTM A165. Posts, and exposed metal items shall have phosphate treatment Fed. Spec. TT-C-490B and door manufacturer's standard finish.	
	5.5 Folding Mechanism:	

Notes		Revisions
Delete for rigid panel construction. Specify door height.	5.5.1 Flexible panels shall be fabricated with not less than 16 gage metal. Provide on row at top for door up to 12 feet high, two rows at top for door over 12 feet high, single row at bottom, and intermediate rows not over 4 feet center to center. Provide vertical rods minimum 3/16 inch diameter connecting hinges in non-rigid type panels.	
Delete for flexible panel construction.	5.5.2 Rigid panels shall be fabricated with not less than 14 gage metal, pantograph top and bottom.	
Specify door height.	5.6 Lead posts and jamb posts shall be fabricated of not less than 16 gage steel ASTM A525 for door up to 10 feet high and not less than 14 gage for door over 10 feet high.	
Delete "ball bearing" if door is lightweight "closet type" unit.	5.7 Carriers: Carriers shall be nylon, ball-bearing, wheeled type of manufacturers standard for size and weight of door. Locate carriers to provide precision tracking without side play and secure, easy, quiet operation.	
	5.8 Door Covering:	

Notes

Revisions

Delete frame covering if not required.

5.8.1 Door frame shall be covered with material to match existing, attached to frame in such manner that will permit on-site removal and repair.

Revise fabric weight if existing. Substitute one of the following if existing is not flexible fabric panel:

5.8.2 Covering shall be flame-resistant treated and shall not peel, craze, crack, or fade. Fabric covering shall be vinyl coated fabric complying with Fed. Spec. CCC-W-408A & Am 1, 30 ounce per linear yard 54 inches wide.

Composite type covering shall be vinyl coated composition board laminated to a metal sheet conforming to Fed. Spec. CCC-W-408A & Am 1, 36 ounce per lineal yard 54 inches wide.

Laminated panels shall be selected wood or plastic laminate veneer laminated to wood block solid cores of kiln-dried lumber with water resistant adhesives.

Wood panels shall be selected wood kiln-dried units. Wood shall match existing or from manufacturer's standard.

Notes		Revisions
Delete if acoustical rating not required.	5.9 Acoustical rated door shall be manufacturer's standard construction complying with ASTM E90 to provide a STC rating of 40. Door assembly shall include perimeter seal sweep strips for each side, top, and bottom, and sound liner of door manufacturer's standard for door panels. Door shall have manufacturers standard light and sound seal at door lead posts and jamb posts.	
	5.10 Track:	
142 Substitute "aluminum" for "steel" if required.	5.10.1 Track shall be manufacturer's standard steel track with factory applied corrosion resistant finish. Track shall be sized to properly support door operation without damage to track, door, or adjacent surfaces.	
Substitute the following if required to match existing: "Track shall be surface mounted."	5.10.2 Track shall be recessed mounted with necessary subchannel or trim units to form pocket for ceiling mounting.	
Delete if no joints are required.	5.10.3 Sections shall be provided in the maximum lengths practicable. Suitable joint devices shall be provided at each joint to provide permanent track alignment with flush, hairline joint.	

Notes		Revisions
Delete items not required.	5.11 The following accessories shall be provided: Center stop for bi-parting doors. Track switches for door operation. Ceiling contact guard for sound rated door units.	
	5.12 Hardware:	
Specify specific material if necessary to match existing exactly.	5.12.1 Components shall be manufacturer's standard heavy duty metal pulls and latches, of brass or steel with dull chromium plated finish.	
Substitute operation which matches existing such as, one side only or key operated.	5.12.2 Latch shall be operable from both sides of closed door.	
Delete if not required. For FINISH HARDWARE see Section 38710.	5.12.3 Provide deadlock to receive cylinder, operable from both sides. Cylinder lock specification shall be as specified in section Finish Hardware.	
Delete items not required.	5.12.4 The following items shall be provided:	
Substitute if required, nonferrous jamb strip and rubber bumper on lead post for single operating door.	Pendant pull in lead post. Upper draw latch with grip handle. Center molding or strike for bi-parting door.	

Notes		Revisions
	Foot bolts on lead post.	
Request a fabric sample with color under paragraph SUBMITTALS if necessary to match existing.	5.13 Finish: Door finish, fabric, material and color shall be selected from manufacturer's standard.	
Work of other trades needed to prepare opening, shall be included and identified if required.	6.0 PREPARATION: Installer shall examine the conditions under which the door units or accessories are to be installed. Conditions which will be detrimental to proper door operation shall be corrected before proceeding with the work.	
Add specific instructions for component repair in detailed specifications. Whether to remove and factory repair, to repair in place, or replace with new.	6.1 Items removed for repair shall be removed carefully so as not to damage other components. Components shall be removed, identified, temporarily packaged, protected and kept ready for reassembly after items have been repaired.	

Notes

Revisions

6.2 Surrounding surfaces shall be protected from damage resulting from this work. Existing materials or surfaces which have become damaged as a result of the operations of this work shall be restored to match condition prior to start of work.

Delete if not required.

6.3 Temporary dust barriers, partitions, or thermal barriers shall be provided, then removed when no longer needed.

6.4 Removal of existing materials shall be limited to only that required for the repair or replacement of the specified items. Removed materials and accessories which are to be salvaged shall be handled carefully to prevent damage to these items.

Materials which can be saved to the benefit of the using agency must be identified and a place of storage identified.

6.5 Salvageable materials, equipment or accessories which cannot be reused as part of the repaired or replaced unit shall be delivered and stored at a location at the site as directed by the Contracting Officer. Trash and materials not to be salvaged shall be removed from the site.

Notes

Revisions

6.6 Cutting, Patching, and Other Related Work:

6.6.1 All work to be performed under this contract shall be executed in a careful and orderly manner by workmen skilled in their respective trades or class of work. The work shall consist of furnishing and installing all new work and doing all necessary cutting, removing, patching, filling in, repairing and altering of existing work to accommodate the new work specified to be installed.

6.6.2 Existing work shall be removed where indicated on the drawings or in these specifications. The materials and methods of application for new work and for patching, filling-in and repairing shall be similar and equal in quality to the removed materials when they were new, and shall be installed in accordance with standard trade practices.

7.0 TECHNICAL PROVISIONS:

Notes

Revisions

7.1 Inspection: Before installation, installer shall check that replacement doors and accessories are free from visible defects and comply with specifications as to type and size and that components will operate with existing equipment. Correct deficiencies prior to installation.

Delete if component repair only. Refer to Part II. Be sure items in Unit Price Schedule are covered by a specification.

7.2 Installation of Door Units: Doors shall be installed or repaired by the manufacturer or his authorized representative in accordance with manufacturer's instructions. Door units shall be installed complete with all necessary anchors and inserts, guides, brackets, hardware and other accessories. Upon completion of installation, doors shall be free from warp, twist, or distortion.

Delete if complete door unit is replaced. Refer to Part II. Add specific instructions for repair of damaged components and panels or frames. Be sure the deficient items on the DEFICIENCY CHECK-LIST are covered by a specification.

7.3 Component Repair and Installation: All door components shall be installed in accordance with the requirements of the manufacturer's printed instructions. Repaired items shall be installed to match operation, function and finish of original installation.

7.4 Cleaning of Components: All components shall be cleaned of all paint, dirt, oil, grease or other obstructions which prevent normal operation.

Notes

For INTERIOR PAINTING see Section 50200. Be sure that drawings specify type and number of finish coats.

7.5 Painting: Finish painting of doors shall be as indicated on the drawings or as provided in sections covering Painting.

7.6 Adjustment and Cleanup: Upon completion, test operation of installation to insure satisfactory operation. Check moving parts for proper lubrication and make adjustments for smooth, easy operation.

Revisions

PART IV

		Comments
38340	Folding Doors	

SECTION 38340

FOLDING DOORS

Revisions

1.0 SCOPE: This specification covers the requirements for replacement or repair of folding (accordion) doors.

2.0 APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

2.1 Federal Specifications (Fed. Spec.):

CCC-W-408A & Wall Covering, Vinyl Coated.
AM #1

TT-C-490B Cleaning Methods and Pretreatment of Ferrous Surfaces for Organic Coatings.

2.2 American Society for Testing and Materials (ASTM):

A164-71 Electrodeposited Coatings of Zinc on Steel.

A165-71 Electrodeposited Coatings of Cadmium on Steel.

A525-75 Sheet Steel, Zinc Coated (Galvanized) by the Hot Dip Process, General Requirements.

B211-73 Aluminum Alloy Bars, Rod, and Wires.

E84-75 Surface Burning Characteristics of Building Materials.

E90-75 Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

3.0 SUBMITTALS:

Revisions

3.1 Shop drawings shall be submitted for doors and accessories not fully detailed in manufacturer's literature. Approval shall be obtained before fabrication or delivery of material. Drawings shall show types, sizes, locations, metal gages, hardware provisions, and installation details and procedures. Include field measurements and clearances.

3.2 Manufacturer's literature shall be submitted which includes installation and operating instructions, and maintenance recommendations.

3.3 Certificates shall be submitted certifying that new doors and accessories meet the referenced standards.

3.4 Sound Transmission Certification: A certificate from an independent testing laboratory shall be submitted as evidence that door unit has been tested in accordance with ASTM E90 to achieve the specified Sound Transmission Classification (STC).

3.5 Flame Spread Rating Certificate: A certificate from an independent testing laboratory shall be submitted as evidence that the door unit has been tested and complies with ASTM E84 for the rating specified.

4.0 DELIVERY AND STORAGE:

4.1 Doors and accessories shall be delivered wrapped in protective coverings, new items in unopened original packages with labels intact, and identifications clearly marked. Damaged items shall be replaced at no additional cost to the Goverment.

4.2 All items shall be stored in a manner that will prevent deterioration or damage. All items for each door location shall be stored together.

Revisions

4.3 Doors shall be handled carefully to prevent damage to faces, edges and ends. Accessories and parts shall be handled to prevent damage to mating surfaces and to fastening points.

5.0 MATERIALS:

5.1 The manufacturer shall be a recognized producer of the type of door and accessories specified. Each new door unit shall be a complete unit produced by one manufacturer including hardware, accessories, mounting, and installation components.

5.2 Local approvals required for the performance of this work shall be obtained prior to fabrication of assemblies or installation of materials. All work performed shall meet the requirements of local codes and regulations.

5.3 Door shall be full pantograph or "x-accordion" type with flexible fabric panels.

Materials shall have a flame spread rating of 25 or less, fuel contributed of 10 or less, and a smoke developed rating of 5 or less, in compliance with ASTM E84.

5.4 Framework for door including posts, pantographs, hinges and hinge plates, and support rods shall be ferrous metal. All enclosed metal shall be galvanized ASTM A164, or cadmium plated ASTM A165. Posts, and exposed metal items shall have phosphate treatment Fed. Spec. TT-C-490B and door manufacturer's standard finish.

5.5 Folding Mechanism:

5.5.1 Flexible panels shall be fabricated with not less than 16 gage metal. Provide one row at top for door up to 12 feet high, two rows at top for door over 12 feet high, single row at bottom, and intermediate rows not over 4 feet center to center. Provide vertical rods minimum 3/16 inch diameter connecting hinges in non-rigid type panels.

Revisions

5.5.2 Rigid panels shall be fabricated with not less than 14 gage metal, pantograph top and bottom.

5.6 Lead posts and jamb posts shall be fabricated of not less than 16 gage steel ASTM A525 for door up to 10 feet high and not less than 14 gage for door over 10 feet high.

5.7 Carriers: Carriers shall be nylon, ball-bearing, wheeled type of manufacturers standard for size and weight of door. Locate carriers to provide precision tracking without side play and secure, easy, quiet operation.

5.8 Door Covering:

5.8.1 Door frame shall be covered with material to match existing, attached to frame in such manner that will permit on-site removal and repair.

5.8.2 Covering shall be flame-resistant treated and shall not peel, craze, crack, or fade. Fabric covering shall be vinyl coated fabric complying with Fed. Spec. CC-W-408A & Am 1, 30 ounce per linear yard 54 inches wide.

5.9 Acoustical rated door shall be manufacturer's standard construction complying with ASTM E90 to provide a STC rating of 40. Door assembly shall include perimeter seal sweep strips for each side, top, and bottom, and sound liner of door manufacturer's standard for door panels. Door shall have manufacturers standard light and sound seal at door lead posts and jamb posts.

5.10 Track:

Revisions

5.10.1 Track shall be manufacturer's standard steel track with factory applied corrosion resistant finish. Track shall be sized to properly support door operation without damage to track, door, or adjacent surfaces.

5.10.2 Track shall be recessed mounted with necessary subchannel or trim units to form pocket for ceiling mounting.

5.10.3 Sections shall be provided in the maximum lengths practicable. Suitable joint devices shall be provided at each joint to provide permanenet track alignment with flush, hairline joint.

5.11 The following accessories shall be provided:

Center stop for bi-parting doors.
Track switches for door operation.
Ceiling contact guard for sound rated door units.

5.12 *Hardware:*

5.12.1 Components shall be manufacturer's standard heavy duty metal pulls and latches, of brass or steel with dull chromium plated finish.

5.12.2 Latch shall be operable from both sides of closed door.

5.12.3 Provide deadlock to receive cylinder, operable from both sides. Cylinder lock specification shall be as specified in section Finish Hardware.

5.12.4 The following items shall be provided:

Pendant pull in lead post.
Upper draw latch with grip handle.
Center molding or strike for bi-parting door.
Foot bolts on lead post.

Revisions

5.13 Finish: Door finish, fabric, material and color shall be selected from manufacturer's standard.

6.0 PREPARATION: Installer shall examine the conditions under which the door units or accessories are to be installed. Conditions which will be detrimental to proper door operation shall be corrected before proceeding with the work.

6.1 Items removed for repair shall be removed carefully so as not to damage other components. Components shall be removed, identified, temporarily packaged, protected and kept ready for reassembly after items have been repaired.

6.2 Surrounding surfaces shall be protected from damage resulting from this work. Existing materials or surfaces which have become damaged as a result of the operations of this work shall be restored to match condition prior to start of work.

6.3 Temporary dust barriers, partitions, or thermal barriers shall be provided, then removed when no longer needed.

6.4 Removal of existing materials shall be limited to only that required for the repair or replacement of the specified items. Removed materials and accessories which are to be salvaged shall be handled carefully to prevent damage to these items.

6.5 Salvageable materials, equipment or accessories which cannot be reused as part of the repaired or replaced unit shall be delivered and stored at a location at the site as directed by the Contracting Officer. Trash and materials not to be salvaged shall be removed from the site.

6.6 Cutting, Patching, and Other Related Work:

Revisions

6.6.1 All work to be performed under this contract shall be executed in a careful and orderly manner by workmen skilled in their respective trades or class of work. The work shall consist of furnishing and installing all new work and doing all necessary cutting, removing, patching, filling in, repairing and altering of existing work to accommodate the new work specified to be installed.

6.6.2 Existing work shall be removed where indicated on the drawings or in these specifications. The materials and methods of application for new work and for patching, filling-in and repairing shall be similar and equal in quality to the removed materials when they were new, and shall be installed in accordance with standard trade practices.

7.0 TECHNICAL PROVISIONS:

7.1 Inspection: Before installation, installer shall check that replacement doors and accessories are free from visible defects and comply with specifications as to type and size and that components will operate with existing equipment. Correct deficiencies prior to installation.

7.2 Installation of Door Units: Doors shall be installed or repaired by the manufacturer or his authorized representative in accordance with manufacturer's instructions. Door units shall be installed complete with all necessary anchors and inserts, guides, brackets, hardware and other accessories. Upon completion of installation, doors shall be free from warp, twist, or distortion.

7.3 Component Repair and Installation: All door components shall be installed in accordance with the requirements of the manufacturer's printed instructions. Repaired items shall be installed to match operation, function and finish of original installation.

Revisions

7.4 Cleaning of Components: All components shall be cleaned of all paint, dirt, oil, grease or other obstructions which prevent normal operation.

7.5 Painting: Finish painting of doors shall be as indicated on the drawings or as provided in sections covering Painting.

7.6 Adjustment and Cleanup: Upon completion, test operation of installation to insure satisfactory operation. Check moving parts for proper lubrication and make adjustments for smooth, easy operation.

APPENDIX D

LIST OF COMPUTER PROGRAMS FOR SOLVING ENGINEERING PROBLEMS

DCS/ENGINEERING & SERVICES PROGRAM CATALOG

(Compiled by AFLC/DEMG, 25 Oct 74)
(For Assistance call Autovon 787-2923/3793)

Program	Description
HSCBCI	This program preforms calculations for cathodic protection systems using high silicon chrome bearing cast iron (HSCBCI) anodes.
PIPELINE	This program use the Williams-Hazen relation to calculate friction loss in a closed conduit. The program. (Developed by Robins)
ACFTLIMS	Compares maximum weights of civil and military aircraft with the airfield evaluation report and lists by feature those aircraft the feature will not support.
SEWER	Sizes and sets slopes for gravity sewers, or calculates capacities of existing systems.
OPENCF	Computes flow of water in open ditch
KVA-EVAL	Computes KVA to verify electric bills.
CONVRT	Converts measurements between scales, e.g., feet to meters, etc.
PAVE-EST	Estimates tons of mat'l and cost to pave a road, pk'g lot, etc.
LIGHT	Determines nr of fixtures reqd for a specified lighting level.
BUSSSHOR	Determines fault current for interior electrical systems
SHORTCIR	Power system analysis; computes fault currents and bus voltages
SZSYSPSY	Psychronometric properties of conditioned air--single zone.
MZSYSPSY	Same as above but for multi-zone air conditioning systems.

SECAP	Determines capacities of wf & i steel beam sections.
MANDSD	Calculates mean, variance and standard deviation.
HYDRAULC	Hydraulic network analysis; hardy cross method; flow & head loss
COLUMN	Design of beam-column; ultimate-strength interactive equations
CIRCLE	Divides a circle into n equal parts; calc's horiz/vert coords.
CPM	Construction mgmt/project memt; critical path technique
PLOTTO	Simultaneously plots from 1 to 6 mathematical functions.
STRESS	Structural engr system solver; for indeterminant structures.
FLEXPAV	Airfield pavement load capacity evaluation--flexible pvmts.
RIGIDPAV	Same as above but for rigid airfield pavements.
SPHERE	Solves any spherical triangle
DSGN-SCH	Engineering Design Schedule--- Compares design worload to manpower availability and computes project start and completion dates.
SERVCALL	Sorts, selects & summarizes service call data for analysis
ABACUS	Equivalent to a high powered desk calculator.
EDITOR	Information retrieval, text editing, etc.
TRAVANAL	Traverse anlysis/data reduction for surveys and layouts.
SLOPSTAB	Slope stability analysis; constructed or natural slopes.
CONTGIRD	Continuous girder analysis reactions, shears bending moments.

COMPBEAM	Concrete-steel composite beam analysis; compute size/stress.
RETNWALL	Retaining wall design and analysis; cantilever & gravity types.
ERTHWORK	Earthwork; preliminary design, and cut & fill quantities.
HORZGEOM	Horizontal geometry; curves, line intersections, subdivisions.
LGHTECON	Determines the most economical lighting system--
VEHICLES	---Vehicle use analysis--- This program provides a capability for summarizing/analyzing a large amount of vehicle use data.

APPENDIX E

PROCEDURE FOR JUSTIFYING AUTOMATIC TYPING EQUIPMENT FOR THE ENGINEERING AND CONSTRUCTION BRANCH

The purpose of this appendix is to provide the Base Civil Engineer with minimum guidance on how to justify automatic typing equipment for his Engineering and Construction Branch. Located in this branch is his highly paid professional engineering staff. In today's Air Force environment of reduced budgets and manpower authorizations it is imperative to utilize the professional engineers' available time as efficiently as possible. With this in mind, relieving them of any unnecessary tasks is of major importance. With current manual typing methods it is necessary for the engineer to review and proofread all of his project related correspondence. A major portion of this workload is project specifications. Automatic typing equipment can reduce the engineer's review and proofreading time by as much as 78 percent. Depending on the number of engineers assigned, this represents a substantial number of engineer manhours that can be redirected to actual project design.

Automatic typing equipment particularly lends itself to producing repetitive text material from a master file. The U.S. Army Corps of Engineers is currently developing master guide specifications for maintenance, repair, and alteration of existing facilities. These guide specifications will cover all areas of maintenance repair and

alteration of existing real property facilities and will be available for Air Force use. Each Engineering and Construction unit that can justify automatic typing equipment should do so immediately, not only to be prepared for the Army's new specifications but to also reap the benefits and savings attainable over its current method of operation.

As an initial step, determine the required number of pages of project specifications that must be produced using automatic typing methods in order to break even cost-wise with the manual typing method. This is identified as the first step in order to demonstrate the high cost of producing specifications and the potential savings attainable by acquiring automatic typing equipment. Use the following procedure to determine, first, the cost per page of specifications using current manual methods and then the required number of pages necessary to be produced to break even with the cost of using the manual method.

$$CPP = \frac{(E \times SE) + R(T \times ST) + EC}{P} \qquad (1)$$

where

CPP = cost per page
E = the number of design engineers producing specifications
SE = the portion of an engineer's salary spent reviewing and proofreading specifications determined as follows:

Determine the mean salary level of all engineers, adding retirement, health, and life insurance costs of 28.7 percent.

Determine the amount of available engineering time which is actually spent doing project design or is project related. This can be determined from cost records utilizing the time accumulated against design work orders versus available engineering manhours.

Determine by survey of personnel the percent of design time an engineer spends preparing specifications. Past studies indicate this value should be somewhere in the range of 30 percent. Check with the local Management Evaluation Team (MET) to determine if a standard has been developed for this work function. At the time of this writing, the Dover AFB MET was in the process of developing a manpower standard for this and other engineering functions.

Lastly, determine the percent of an engineer's specification preparation time that is spent reviewing and proofreading manually typed specifications. If this value is unavailable, use 40 percent. This value was determined by an extensive Corps of Engineers study on specification preparation.

Thus, the amount of engineers salary spent reviewing and proofreading manually typed specifications is found by: (Average salary of engineers including retirement and benefits) x (percent of time performing actual design) x (percent of design time an engineer spends preparing specifications) x (.40 or actual percent determined by survey) = SE

R = retyping factor = 2 if comparing manual typing to any other method. This accounts for having to retype everything at least once using the manual method.

T = number of typists devoted to specifications (can be a fraction or whole number; i.e., .5, 1.0, 1.5, 2.0, etc.)

ST = typists salary including retirement and benefits of 28.7 percent

EC = annual equipment costs for manual typing

P = number of pages of specifications produced (a good estimate is the average number of projects designed per year multiplied by the average number of pages per project)

Next, determine the number of pages of specifications required using automatic typing equipment required to break even with the cost of using the manual method.

$$RNP = \frac{(E \times SE \times RFE) + R(T \times ST \times RFT) + EC}{CPP} \qquad (2)$$

where

RNP = required number of pages to break even

CPP = as determined by Eq (1)

E, SE, T, R, and ST are the same as determined for Eq (1)

RFE = reduction factor for engineers. The savings in engineer review and proofreading time when using automatic typing equipment, as determined by an extensive Corps of Engineer specifications study,

is 78 percent. Thus, the reduction factor, RFE, is .22.

RFT = reduction factor for typists. The savings in typing, review and revision time for the typist using automatic typing equipment over manual equipment, as determined by the same Corps of Engineer study, is 39 percent. Thus the reduction factor for typists, RFT, is .61.

These two computations not only reveal the high cost of producing project specifications but also the minimum workload necessary to justify automatic typing equipment when considering only project specifications. When the total typing workload of the Engineering and Construction Branch is included in the justification substantially more savings can be realized.

In order to justify automatic typing equipment for the Engineering and Construction Branch, existing procedures/ regulations must be satisfied. The following procedure should be used as a minimum guide.

1. Review Air Force Manual 67-1, Volume IV, Part I, Amendment 18, paragraph 81, Automatic Typing Equipment, dated 17 September 1973.

2. Review Air Force Regulation 4-2, Volume I, dated 15 October 1976, and AFR 4-2, Volume II (currently in publication). Contact the Chief of Base Administration before performing any extensive study. The Administration Branch is responsible for conducting and

monitoring administrative systems studies and for justifying requirements for rental of administrative system equipment in budget requests in accordance with AFR 4-2, Volume I. They should, as a minimum, assist the unit in preparing a detailed study, if necessary, as part of the justification for the unit's requirements. Assistance from that office can be invaluable.

3. In addition to the above assistance provided by Base Administration, the following guidelines are intended to aid the requestor in providing proper justification as required by Air Force Manual 67-1:

a. Percentage of time the equipment will be required. (This must be more than 80 percent of a normal work day. The data supplied in answer to the remaining points will provide an estimate of the figure to be placed here. A statement based on the following computations stating that it is estimated that the equipment will be used at least 80% of the time is necessary.)

b. Average number of pages to be typed per week. The assumption is made here that all typing produced must be retyped at least once; therefore a factor of 2 should be applied. For the Engineering and Construction Branch only, the following documents should be included as a

minimum. This list should be detailed, indicating the specific type of document and its frequency.

(Since the objective of this effort is to assist the Engineering and Construction Branch to obtain automatic typing equipment for their use, a concerted effort should be made to justify the equipment based on the workload of this Branch only. However, if there is insufficient workload to justify equipment solely for Engineering and Construction, consideration should be given to including recurring and repetitive work from other branches.)

1) Average number of pages of specifications typed per year.
2) Average number of pages of engineering studies typed per year.
3) Average number of pages of project related correspondence typed per year.
4) Average number of pages of project development booklets typed per year.
5) Average number of pages of miscellaneous documents such as environmental studies and Architectural-Engineer statements of work typed per year.

6) Average number of pages of miscellaneous office correspondence typed per year.

7) Total pages typed for Engineering and Construction (1), 2), 3), 4), 5), and 6) x 2 = total number of pages typed per year. Do not use this figure for Eqs (1) and (2); it will be used later in this procedure.

8) Total pages typed per week = (7)/48 work weeks/year. This figure can be used for justification IAW AFM 67-1. Additionally, the typing workload can be determined with a workload survey as outlined in Draft Air Force Regulation 4-2, Volume II. This survey will yield the workload in lines typed per day. To be compatible, convert 8) to lines per day as follows: (pages per week)/(5 days per week) x 45 lines per page (unless odd sized documents are used, then adjust accordingly) = number of lines per day.

c. The results of item b (8) or the extensive survey IAW AFR 4-2 will yield the total number of lines per day. This figure can then be used to determine the number of magnetic typewriters required to satisfy the workload. The following is extracted from Draft AFR 4-2, Volume II:

1) Convert the daily average lines per day to lines per month by multiplying the daily average by 20.99, the number of monthly workdays. ___ lines/day x 20.99 = lines/month.

2) Convert lines per month to mandays by dividing by the expected machine performance factor for mixed typing of 700 lines/day. ___ lines/month ÷ 700 lines/day = mandays/month.

3) Convert mandays/month to number of people and thus number of machines required to accomplish the workload by dividing by the number of productive mandays/month available per employee. ___ mandays/month ÷ 16.5 days/month = # employees and machines required. Acceptable machine utilization should average more than five hours per day or .625 days based on an 8 hour day. If the above figure for the number of employees and machines is less than .625 the engineering and construction unit should consider consolidating requirements from other functions to include in the workload computations.

d. Cost Analysis. The following cost analysis will be based on the assumption that all typing for

the Engineering and Construction Branch is to be accomplished on automatic typing equipment. If this is not to be the case, the unit should adjust accordingly. Normally only realizable capital savings such as a reduction in the number of positions authorized should be used in a cost analysis. However, since one of the main objectives in using automatic typing equipment is to save the engineer time in reviewing and proofreading typed documents so that this time can be reallocated to much needed design work or other important engineering functions requiring his professional expertise, the savings in engineer time and salary must be included in the analysis and justification. Capital savings resulting from the reduction of clerical positions will obviously be included. However, if there is only one typist serving the entire engineering design staff, and automatic typing equipment is justified, the position obviously cannot be eliminated. In this case, a capital savings cannot be realized, but the savings in the typist's time realized by using automatic typing equipment should be calculated and credited just as the engineers' time savings was credited.

Following is a sample procedure for a cost analysis to be used as a part of the overall justification for automatic typing equipment.

1) Determine the amount of engineers' salary spent reviewing and proofreading specifications (SE). The value of SE as determined for Eq (1) is found by: (average salary of engineers including retirement and benefits) x (percent of available time performing actual design) x (percent of design time an engineer spends preparing specifications) x (.40 or the actual value determined from survey for the percent of an engineer's specification preparation time that is spent reviewing and proofreading manually typed specifications).

   Since the engineers also review and proofread normal project correspondence the above figure will necessarily yield a conservative estimate. If the review and proofreading time of this additional correspondence can be determined it should also be added to the above computation.

2) Determine the amount of engineers review and proofreading salary saved by using

automatic typing equipment. From a Corps of Engineer survey, the savings in engineer review and proofreading time by using automatic typing equipment as compared to manual typing equipment is 78 percent.

Savings = (.78) x (SE found in d (1) above)

3) Determine typist savings as result of using automatic typing equipment. From a Corps of Engineer survey, the savings in typing, review, and proofreading for the typist is 39 percent.

Savings = (number of typists using automatic typing equipment) x (typists salary including retirement and benefits) x (.39)

4) Determine the annual cost of leasing automatic typing equipment from existing GSA contract price schedules. Recommend a dual station machine be requested because of the advantage of simultaneous editing from a master card or tape while developing a magnetic copy of the altered text. This capability is ideal for producing project specifications from master specifications. Annual cost should include an estimate for

magnetic cards or tapes depending on type of unit requested plus other features ordered. (AFR 4-2, Vol II (Draft) includes an entire section on selection of equipment and optional features.)

5) Determine the annual savings by adding the annual engineer and typist savings and subtracting equipment costs. Additional tangible savings such as typists overtime costs should also be included if applicable.

6) Intangible savings such as the elimination of contractual problems due to typing errors, savings in procurement and legal review time, timely accomplishment of specifications perhaps resulting in additional project funds for the base, and the savings in engineer manhours (savings found in d (2) divided by average hourly wage of engineers) that can now be reallocated to more meaningful work such as project design should be discussed and included in the justification.

7) Any other information which will add to the justification should also be included.

e. Special equipment features should include reverse search and red ribbon shift for corrections. This capability will enable faster editing and typing of master specifications and more rapid review of material containing changes or corrections.

Example: The following parameters are assumed for the purposes of this example:

1) 12 design engineers, average grade GS-11, step 4
2) 1.2 typists devoted to specifications, average grade GS-4, step 4
3) existing equipment is electric manual typewriter
4) 75 projects designed per year, with an average size of 35 pages per project
5) results of extensive survey of Engineering and Construction Branch total typing workload yields 525 lines of typing per day
6) IBM MagCard II automatic typing equipment will be requested
7) cost records reveal 45 percent of engineers time spent doing actual project design
8) survey yields 30 percent of engineers design time preparing specifications
9) survey yields 40 percent of engineers specification preparation time spent reviewing and proofreading specifications

Computing values for Eq (1) yields:

engineers salary = \$18763/yr + .287 (for retirement and benefits)(18763) = \$24148/yr

SE = (average salary of engineers including retirement and benefits) x (percent of time performing actual design) x (percent of design time an engineer actually spends preparing specifications) x (percent of engineers specification preparation time spent reviewing and proofreading specifications)

SE = (24148) x (.45) x (.30) x (.40) = \$1304/yr

ST = \$9147 + .287(9147) = \$11772/yr

EC, computed from current GSA price schedules for IBM Selectric yields: yearly cost based on \$800 purchase price using 10 percent discount factor and 5 year life (replacement after 5 years) is 800(crf, 10%, 5 yrs)

800(.16275) = \$130/yr

Using Eq (1):

$$CPP = \frac{(12 \times 1304) + (2 \times 1.2 \times 11772) + (2 \times 130)}{(75)(35)}$$

CPP = \$16.82/page of specification produced

Using Eq (2):

$$RNP = \frac{(12 \times 1304 \times .22)+(2 \times 1.2 \times 11772 \times .61)+(4529 + 130)}{16.82}$$

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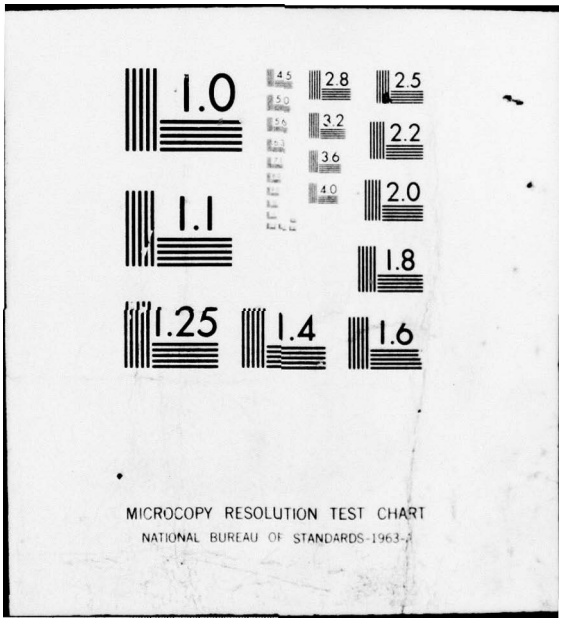
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EC for IBM MagCard II from current GSA price schedules is $4529/yr including maintenance and one year supply of cards.

RNP = 1506 pages/year

This result indicates that the unit need only produce 1506 pages of specifications per year in order to pay for the cost of using automatic typing equipment. If the sample year is a typical year, (75)(35) = 2625 pages will be produced annually, well above the required 1506 pages. Also, the cost per page produced will be reduced from $16.82 to $9.65, a substantial savings. Assuming the same average number of pages of specifications will be produced per year the savings will be ($16.82/page - $9.65/page)(75 projects)(35 pages/project) = $18,821.

Determine the number of typewriters required to accomplish the workload of 525 lines per day.

(525 lines/day)(20.99 monthly workdays) = 11020 lines/month

The number of mandays required to accomplish the workload by automatic typing equipment is

(11020 lines/month)÷(700 lines/day) = 15.74 mandays/month

The number of typists and automatic typewriters required is

(15.74 mandays required/month)÷(16.5 mandays/month/typist)

= .954 typists and automatic typewriters

The savings as a result of using automatic typing equipment has already been computed as $18,821/yr. However, to put it in more meaningful terms, add the savings in engineer's salary resulting only from reduced review and proofreading time of specifications and the savings in typist's salary as a result of using automatic typing equipment, and then subtract the equipment costs.

(.78)(E)(SE)+(.39)(2)(T)(ST)-EC

(.78)(12)(1304)+(.39)(2)(1.2)(11772)-(4529-130)=$18,825/yr

Note that the cost of one manual typewriter is being saved. The difference between the above savings and the $18,821/yr computed previously is due to rounding error.

Although this savings is not a capital savings, unless typist positions can be eliminated, it does accurately reflect a substantial savings in manhours. Attributing one-half the cost of equipment against engineer savings yields a savings of (.78)(12)(1304) - .5(4529-130) = $10,006. When using an average GS-11 step 4 hourly rate of $9.02 the resulting savings is 1109 engineering manhours. This is for specifications alone! These manhours can then be reallocated to more important engineering design work rather than the mundane task of reviewing and proofreading typing.

This procedure and example is intended to be used as a minimum guide. Additions and changes to fit local situations are encouraged. The goal is to acquire automatic typing equipment as soon as possible when it is justified.

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